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HOSPITAL BUILDING NOTE 26

OPERATING DEPARTMENT

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Operating department

Ministry of Health Hospital Building Note Number 26

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References

Building Notes recommend the standards of accommodation and services for hospital departments which the Ministry of Health considers it reasonable to provide. Each Building Note contains a Cost Note from which may be derived a Departmental Cost Allowance appropriate to the department. Hospital Boards are at liberty to depart from the design recommendations given in Building Notes provided that they are satisfied that the standards of accommodation and services they adopt are adequate. The Departmental Cost Allowance, however, is to be regarded as the maximum sum of money available for the department and it should not be exceeded. Hospital Boards are encouraged to produce designs for the provision of appropriate accommodation and services at a cost less than the Departmental Cost Allowance.

An addendum to Appendix E of Hospital Building Note No 2, The Cost of Hospital Buildings, which sets out cost recommendations for the Operating Department, is supplied with this Building Note.

1 Scope

1. This Building Note gives guidance on the design of operating departments in both district general and teaching hospitals, though some special factors affecting the latter are not considered here. The guidance given is applicable to all theatres and ancillary rooms, but in the case of theatres located away from the main departments (e.g. those in the maternity department or the accident and emergency department) it should be applied in the light of the content of the Building Notes dealing with those departments.

2. The number and complexity of the functions carried out in the operating department create several problems, both in design and in the formulation of operational policies. The recommendations in this Note should be regarded primarily as an account of the desirable to be attained whenever practicable, and not, so far as the design recommendations are concerned, as invariably valid. Much study remains to be done before the ideal layout can be established and experimentation in various methods of implementing the most important recommendations in this Note is to be welcomed.

2 General considerations

3. This Note largely revises Hospital Building Bulletin No. 1, Operating Theatre Suites, and therefore replaces it. It has been prepared in co-operation with the Scottish Home and Health Department and takes account of the recommendations in a Report of the Royal College of Surgeons of England on the Design of Operating Theatre Suites and a Report in 1962 to the Medical Research Council by the Operating-Theatre Hygiene Sub-Committee of their Committee on the Control of Cross Infection. The main changes suggested, as compared with the Bulletin, are as follows:

(*a*) The Bulletin was concerned primarily with the provision of small departments to supplement facilities available at existing hospitals. Nowadays the need is to provide significantly larger departments for new or redeveloped hospitals, and this Note assumes that these will normally comprise at least four theatres and usually more.

(*b*) These larger departments involve a review of methods of organising work, particularly on the cleaning and sterilising of instruments. This Note recommends that all theatre instruments should be cleaned and sterilised centrally either in a unit (theatre sterile supply unit – T.S.S.U.) serving the department, or in the C.S.S.D. where work would be organised to accommodate this function for the operating department. It is unnecessary for each theatre to have its own instrument cleaning and sterilising facilities. The advantages of this centralisation are fourfold:

(i) economy in provision of equipment (mechanical washers, autoclaves, etc.);

(ii) economy in use of nursing staff (some of this work could be done by lay staff, as in the case of the central sterile supply department);

(iii) the removal of sterilising equipment from the immediate vicinity of the theatre reduces undesirable build-up of heat and humidity and eases the problem of air flow control;

(iv) reduction of noise in the theatre associated with washing and sterilising.

A greater capital outlay will probably be required initially to provide more instruments, but this can be limited by a degree of uniformity in packs of instruments and good organisation to maintain a steady flow of sterilised instruments.

(*c*) At the entrance to each department there should

be a reception and transfer area where, if necessary, patients may also be held while waiting to go into the anaesthetic room.

(*d*) The recommendations on operating theatre hygiene made by the M.R.C. Sub-Committee are incorporated virtually *in toto*. However, the recommended clean movement lobby (separate from patient circulation routes and for use only by staff who have changed into theatre clothing) must inevitably lead to complexities in planning. The alternative suggested by the Sub-Committee, i.e. the division of the entrance lobby into an outer transfer area and an inner portion accessible only to changed staff but used also by patient traffic which has passed through the transfer area, has much to commend it. (See Figures 5(*a*) and (*b*).)

(*e*) It is recommended that the air supply to the theatres themselves should be at a rate between 1,000 and 1,200 cu ft per minute. Different rates of air input are recommended for some of the other rooms. Details are given in Section 5 of this Note.

4. In general, the principles and space standards described in this Note are applicable to all multi-theatre departments and are valid for departments forming part of the clinical areas of teaching hospitals.

5. The general considerations affecting the design of the department are described under the following heads:

(*a*) Concentration of operating and sterilising facilities;
(*b*) Location of department within the hospital;
(*c*) Relationship with other departments;
(*d*) Functions within the department which affect design.

Concentration of operating and sterilising facilities

6. As a general principle, all theatres should be grouped together in the hospital complex, so as to be independent of the general traffic and air movement of the rest of the hospital, although in considering the location of the theatres serving the maternity, accident and emergency and out-patient departments reference should be made to the Building Notes dealing with those departments. The approach recommended in these Notes is that major surgery arising from the work of these departments should where practicable be done in the main operating department, though theatres adequate to handle minor surgical cases may be provided in the departments individually. The principle of grouping all theatres in one department may, therefore, lead to reconsideration of the need for theatres in individual departments, especially where the hospital as a whole is compactly planned and there is easy communication between the operating department and the maternity, accident and emergency and out-patient departments. There will, however, be many exceptions to this principle, as for example where the maternity department is planned in a separate block at some distance from the main operating department. Again, nothing in this Note detracts from the force of the planning considerations affecting accident and emergency departments, as set out in paragraph 5 of Hospital Building Note No. 22.

7. Concentration of operating facilities gives maximum flexibility and economy in use when programming surgical work; it simplifies supply and disposal arrangements, and allows maximum economy in staff, main plant, service rooms and running costs of the engineering services. Space economy is achieved by the centralisation of common ancillary accommodation (stores, staff changing and rest rooms) and by the provision of recovery space as a single unit close to all theatres.

8. Minor operating theatres (or treatment rooms) in accident and emergency and out-patient departments and delivery suites should be supplied with sterile packs and instruments either from a C.S.S.D. (whether located in the hospital or at some other hospital or hospital industrial services site) or from the T.S.S.U. of the operating department where one exists.

Location of operating department

9. The department should be accommodated on a single floor of the building, and the siting should in general meet the points made by the M.R.C. Sub-Committee, viz:

'The traditional place for an operating-suite in a multi-storeyed hospital is the top floor. This is perhaps a legacy from the days when skylights were necessary for illumination of the operating-room. It has also been reasoned that here, away from the activity of the wards and corridors, are to be found the quiet and the freedom from bacterial contamination that are needed for surgical operations. Recently, since plenum ventilation has become an accepted practice in operating suites, engineers have favoured the top floor because ventilation plants can be conveniently housed in the roof space or in special buildings on a flat roof, with short and direct routes for the air-ducts from the plant to the suite.

'In fact, airborne contamination from the wards to the operating rooms may be greatest when the suite is at the top of a tall building because the "stack effect" causes upward air currents through lift shafts and stairways. In a modern operating-suite, properly ventilated by the plenum method, the danger may not be great because the planned directions of air-flow prevent contamination of the operating-room from its surroundings. But planned directions of air-flow are never maintained continuously. Open doors, open windows, and the movement of people to and fro cause eddies and even reversals of flow that are neither easily predicted nor easily prevented. It therefore seems reasonable to site even a well-ventilated operating-suite lower down in the hospital.

'There are other disadvantages to the top-floor suite. With the ventilation plant immediately overhead, noise from the plant may be transmitted to the operating-room through the fabric of the building and along the relatively short air-ducts, whilst solar heat gains in the suite itself and in the air-ducts sometimes cause serious over-heating. These problems strengthen the case for placing the operating-suite away from solar heating on a lower floor, with its ventilation plant in the basement where rigid-based mountings simplify noise control.

'The air intake for the ventilating plant is best sited as far as possible from any sources of bacterial air contamination. This seems to favour placing the plant at high level; but in practice, provided proximity to gross sources is avoided, the precise siting of the intake for air that is to be properly filtered does not seem to be important. It is, however, desirable to avoid situations exposed to high wind pressures, and the air in "well" areas is particularly liable to contamination from sources within the building.'

10. There should be direct and easy communication between the department and the surgical wards. Where the department is located in a block separate from a multi-storey ward block there should be easy and quiet horizontal communication from the department to the lifts serving the ward block – two separate lift journeys for patients and passage through busy corridors are to be avoided. Similar considerations affect the location of departments within multi-storey blocks, and the need to reduce noise, the limitations on design imposed by structural features, and possible provision for future extension must often be taken into account. It is important to site the department in a cul-de-sac, thus allowing control of entry and exit.

Relationship with other departments

Wards

11. The department functions mainly for in-patients. Transport between theatres and wards must therefore be simple – see paragraph 10.

Central sterile supply department

12. Because of the heavy demand placed by the operating department on the C.S.S.D. the relationship between these departments is of considerable significance:

(*a*) where the development being planned includes provision of both a C.S.S.D. and a sizeable operating department (i.e. of four theatres or more) the C.S.S.D. should preferably be located close to the operating department and its arrangement planned so that it can combine the functions – see paragraph 79 below – of a T.S.S.U. for the operating department with the traditional function of a C.S.S.D.;

(*b*) such C.S.S.Ds may often serve several hospitals, and the planning problem then becomes one of balancing the requirement at (*a*) above with the need to locate the C.S.S.D. conveniently to transport facilities to these other hospitals.

Accident and emergency department

13. Accident and emergency department patients requiring major surgery will normally be dealt with in the main operating department and will be nursed in either an intensive therapy area, or in the appropriate ward. Thus an easy route must be provided from the admission and resuscitation rooms of the accident and emergency department to the wards and main operating department.

X-ray department

14. X-ray examination of patients is sometimes necessary during or immediately after surgery. They would not normally be taken to the main x-ray department for this purpose. The provision of built-in x-ray equipment (which is difficult to replace as equipment design develops) is rarely advisable. The generally acceptable solution is to use mobile x-ray equipment within the operating department, to be taken into the theatre when required. Film processing may be done in a simply equipped dark room, and a radiographer sent from the x-ray department to operate the equipment and process the film whenever required. In the future polaroid films may play an important part in theatre radiology.

Laboratory facilities

15. Normally specimens will be examined in the main department of pathology and will be taken there by messenger service. This arrangement is satisfactory provided the department of pathology is not too remote from the operating department. Where exceptionally the two departments are widely separated (e.g. where the hospital laboratory service is integrated with a university department of pathology) it may be necessary to consider the provision of mechanical methods for conveying specimens. Where the type of work justifies it, it may be necessary to provide a simple laboratory within the operating department but in this event care must be taken to ensure that the necessary contact between laboratory and theatre staffs does not lead to breaches in aseptic discipline.

Intensive therapy for critically ill patients

16. Where an intensive therapy unit is provided in the hospital it may conveniently be located near the operating department, and should in that case preferably be adjacent and have direct access to the recovery area, so that specialist staff and equipment may serve both areas.

Functions within the department which affect design

17. The essential chracteristic of the layout of rooms within the department itself is that 'clean' and 'dirty' streams of traffic should be segregated. This principle, interpreted against the flow of traffic determined by the functions of the department, sets fairly precise limits to freedom in design. The following paragraphs analyse the considerations which arise, under the following heads:

(*a*) Basic requirements in design
(*b*) Entrance to the department
(*c*) Circulation within the department
(*d*) Transport of patients
(*e*) Sterilisation procedures
(*f*) Use of ancillary rooms
(*g*) Pre-operative care of patients
(*h*) Immediate post-operative (post-anaesthetic) care of patients
(*i*) Use of staff rooms
(*j*) Air movement
(*k*) Other rooms
(*l*) Integration of engineering services.

(*a*) *Basic requirements in design*

18. The basic design principles are as follows:

(i) clean and dirty streams of traffic should as far as practicable be segregated;

(ii) the department should be independent of the general traffic and air movements of the rest of the hospital (see paragraph 6);

(iii) rooms of the department should be so arranged that there is a continuous progression from the entrance, through zones that increasingly approach sterility, to the operating theatres and theatre preparation rooms;

(iv) staff working within the department should be able to move from one clean area to another without having to pass through unprotected areas;

(v) dirty materials should be removed from the department without passing through a clean area;

(vi) the directions of air-flow within the department should always be from the cleaner to less clean areas (see Figures 7 and 8);

(vii) the heating and ventilation system should

ensure safe and comfortable climatic conditions for patients and staff.

(*b*) *Entrance to the department*

19. Patients, staff and service personnel should enter at the same point, which should be so located as to discourage unauthorised entry. Exceptionally with some types of plan (e.g. where the C.S.S.D. is on a floor immediately adjacent to the theatres) it may be convenient to provide direct, lift or hoist access to the operating department but it is essential that steps should be taken, and firmly applied, to prevent the supplies entrance being used by the staff as a 'back door' to the department.

(*c*) *Circulation within the department* (See Figures 1)

20. The main traffic flows can be identified as follows:

(i) *Patients.* Ward or intensive therapy unit – reception area – transfer area – anaesthetic room – theatre – exit lobby – transfer area – recovery area – intensive therapy unit or ward.

(ii) *Staff.* Entrance – changing rooms – working areas – rest rooms and/or changing rooms – exit.

(iii) *Equipment and supplies*

Clean: entrance – supply area or T.S.S.U. – theatre preparation room – point of use.

Sterile: C.S.S.D. and/or T.S.S.U. – theatre preparation room – point of use.

Dirty: theatre – disposal area – T.S.S.U. and/or C.S.S.D. – laundry, destruction unit or laboratories.

(*d*) *Transport of patients*

21. There are several methods of transporting the patient from his bed in the ward to the operating table: they differ one from another mainly in (i) the practice adopted for taking the patient to the department (in his own bed or after transfer to a trolley in the ward) and (ii) the point at which he is transferred either from his bed or the trolley to the table. Each hospital will decide its own practice, but two general principles should be observed, which in turn will indicate the routing of patients and the relationship of rooms inside the department:

(i) limitation of the number of times the patient is moved (e.g. from bed to trolley and to the table);

(ii) contamination of the clean and sterile zones (the clean corridor, anaesthetic room, and theatre) by wheeling beds or trolleys from the wards into these zones is to be avoided.

22. Care should be taken to ensure that there is no build-up of infection in the reception/transfer and recovery areas. Mechanical ventilation of these areas is desirable.

(*e*) *Sterilisation procedures*

23. It is unnecessary to provide each theatre with separate sterilising facilities and this Note recommends that such facilities required in the operating department should be centralised either in a theatre supply and sterilising unit (T.S.S.U. – see paragraph 3(*b*)), or in the C.S.S.D.

24. The function and planning of the T.S.S.U. where one is to be provided (or the corresponding section of the C.S.S.D.) is described in the 'Description of rooms' (paragraphs 79–83) and illustrated in Figure 2. The assumptions upon which this description is based are as follows:

(i) The main C.S.S.D. (or depot) will supply all dressings, sterile linen, gloves, and syringes, to the clean and sterile storage area of the T.S.S.U. (see (v) in Figure 2). Some items such as sterile injectable and other fluids in suitable bottles will usually be supplied direct from the pharmacy.

(ii) The C.S.S.D. supplies should not be sent direct to individual theatre preparation rooms. The responsibility of the C.S.S.D. is to the department as a whole and not to any individual theatre.

(iii) After sterilisation in the T.S.S.U. the instruments, bowls and receivers, etc. (all wrapped), or the pre-laid trays for each operation, are assembled on a trolley and taken, together with the pre-sterilised packs from the C.S.S.D., clean linen, flasks, etc., to the theatre preparation room attached to each theatre.

(iv) Each theatre preparation room holds the trolley(s) loaded for at least one further operation and also carries a stock of sutures, sterile fluids and a number of spare wrapped instruments, previously sterilised, to replace forgotten or dropped instruments.

(v) There should be effective communication between each theatre preparation room and the T.S.S.U. so that instruments and other materials may be called for in an emergency, if they cannot be provided from the theatre preparation room stock itself.

(vi) Outside each theatre will be a disposal area which is a recess off the disposal corridor. This area could contain cleaning materials for the washing down of floors of the theatre after use; it will also be used as an area for washing large items of equipment (e.g. parts of the theatre table, etc.) and will be the temporary holding bay for used items from the theatre pending removal to the C.S.S.D., T.S.S.U., laundry, or hospital incinerator.

(vii) The disposal corridor links each disposal area to the 'receiving and cleaning' area of the T.S.S.U. (see (i) in Figure 2) to which used instruments, bowls, receivers, etc., are taken on a trolley from the theatre. This corridor also has an exit lobby where items for C.S.S.D., laundry or disposal can be held pending removal.

(viii) Thus to obtain efficient flows of sterile, clean and soiled goods a design based on two corridors is indicated.

25. The routine described in paragraph 24 relates to the case where a T.S.S.U. is provided in the operating department. The same principles will, however, apply where all sterilisation is done in the C.S.S.D., the operational policies suggested in paragraph 24 being adjusted to take account of the fact that materials received in the department from the C.S.S.D. will go first to the sterile store area of the department – see paragraph 66. In such a case, also, regard must be had to such factors as the need for sterile security in transporting materials to the department, arrangements for distributing the materials from the sterile store to the respective theatre preparation rooms, and arrangements for the return and cleaning of trolleys used for this purpose. The solutions decided upon in each case should reflect the general principles set out in this Note concerning the organisation of work within the department.

(f) Use of ancillary rooms

26. Each theatre will require its own anaesthetic room, scrub-up and gowning room, theatre preparation room (all leading directly into the theatre) and a disposal area.

27. An exit lobby will be required through which patients should be taken after operation to the recovery area or ward. They could, if necessary, conveniently be transferred from the operating table to a trolley in this area.

(g) Pre-operative care of patients

28. The concept of grouping a number of theatres in one department, so that numbers of patients arrive together or in swift succession, implies reconsideration of the traffic pattern and organisation hitherto adopted. To allow economy of ancillary room provision and to make the best use of staff, while ensuring flexibility in work load, it is necessary to group the reception and post-anaesthetic recovery areas together, sharing access to and exit from the transfer zone and the clean corridor.

29. All patients should go to a reception area on arrival in the department. This will be a point for holding patients temporarily under suitable conditions, allowing (according to the procedure adopted at the hospital) for the final preparation of the patient. It is convenient to locate this area near to and sharing the ancillary rooms of the recovery area (see paragraph 47).

30. This reception area, where patients will possibly be held for quite short periods, need not be large, since the aim should be so to organise the flow of cases to the department as to reduce waiting in the department itself to a minimum. For a department of eight theatres space for about eight beds in the area may provide a starting point for consideration of requirements in the light of the communications and procedural characteristics of individual hospitals. (See Figure 5.)

(h) Immediate post-operative (post-anaesthetic) care of patients

31. A recovery area should be provided for each department; and if, exceptionally, circumstances dictate that the theatres should be located on two floors, then a recovery area must be provided on each floor. The function of this area is to enable patients to be held under the care of appropriately skilled nursing staff with, when required, relatively easy access to a surgeon or anaesthetist during the immediate post-operative period. Patients who are likely to be a source of infection need not go to the recovery area, but might be held in the theatre until ready for return to the ward. Thus isolation cubicles in the recovery area will not usually be required. Each recovery area should have its own ancillary rooms, shared with the reception area. Patients who require constant supervision for prolonged periods or specialised forms of treatment are best cared for in an intensive therapy unit.

32. The recovery and reception areas should be located so as to be accessible from the hospital side of the department without passing through the clean zone of the department: but they must also be accessible direct from the transfer into the clean zone so as to permit access by a surgeon or anaesthetist to patients after operation.

33. An allowance of one-and-a-half beds per theatre should be adequate for the recovery area, dependent on the nature of the work normally carried out and the degree of post-anaesthetic care envisaged.

(i) *Use of staff rooms*

34. Staff rooms will be required as follows:

(i) Changing rooms with lockers.

(ii) W.c's, basins and showers annexed to (i).

(iii) Rest rooms for medical staff; nursing staff; theatre attendants and orderlies. Separate rooms should be provided for each group, but it is unnecessary to provide separate rooms for each sex within the group.

(iv) The theatre superintendent will require an office (two in large suites where superintendents control different groups of theatres).

35. The staff changing rooms should be located so as to be accessible from both the clean corridor and the outer corridor, but not from outside the department. The rest rooms for each group should be planned close to the changing rooms but be accessible from the clean corridor only.

(j) Air movement

36. The principle upon which ventilation arrangements must be based is that air movement should be maintained from cleaner to less clean areas, i.e. that air movement should be from the preparation room and the theatre to the anaesthetic room; from scrub-up to clean corridor; from the clean corridor to the staff rooms; and from reception and recovery area to the staff outer corridor and entrance area. Similarly in the T.S.S.U. the air movement must be from the cleaner to less clean areas.

37. There should be no movement of air between any one theatre and another. Thus all theatres should have doors to their immediate ancillary rooms. Interconnected or twin theatres with shared ancillary rooms should be avoided.

38. The required pressure and flow are only obtainable if no openable windows exist in the department. It is not essential to provide operating departments with large windows, or the theatres themselves with any windows at all (this point is referred to in paragraph 58 below). The light from them is of little use in illuminating the field of operation and the large areas of glass often cause excessive heat gain in summer.

(k) Other rooms

39. A number of rooms additional to those mentioned above (e.g. plaster room, endoscopy room, and monitoring room in larger or specialised departments) may be required, and in planning the department the flow of traffic stemming from the functions of these rooms must be taken into account.

(l) Integration of engineering services

40. Access to plant for maintenance should be arranged so as to reduce to a minimum the need for maintenance staff to enter the theatres or clean areas. This may be achieved by external access and to some extent by the location of service access points from the staff corridor side of the ancillary rooms, and from the disposal corridor side of the theatres and preparation rooms; and by considering the advisability of horizontal crawlways over false ceilings or a service void. It is important that an awareness of the problems of suitable access to plant should exist from the early stages of design, so that effective maintenance is made possible.

3 List of rooms

(A) Basic accommodation

41. (*a*) *Theatre suites and related rooms*
   (i) Entrance and porters' station
   (ii) Reception/transfer area
   (iii) Changing rooms (and sanitary facilities)
   (iv) Rest rooms
   (v) Office for theatre superintendent
   (vi) Office for theatre sisters (where appropriate)
   (vii) Scrub-up and gowning area
   (viii) Theatre preparation room
   (ix) Anaesthetic room
   (x) Operating theatre
   (xi) Exit lobby
   (xii) Disposal and cleaning area
   } One theatre suite
   (xiii) Disposal corridor
   (xiv) Stores
   (xv) Store for mobile x-ray
   (xvi) Darkroom
   (xvii) Tea pantry
   (xviii) Recovery area
   (xix) Ancillary rooms (clean and dirty utility) for recovery room and reception/transfer area
   (xx) Cleaners' room
   (xxi) Plant room(s)
   (xxii) Circulation space necessary for the above accommodation.

(*b*) *Theatre sterile supply unit* (for departments with no nearby C.S.S.D.)
   (i) Receiving and cleaning area
   (ii) Examining and storing area
   (iii) Packing area
   (iv) Sterilising area (including servicing area)
   (v) Storage for clean and sterile goods
   (vi) Loading area
   (vii) Delivery area
   (viii) Circulation space necessary for the above accommodation.

(*c*) *Sterile store* (where no T.S.S.U. is provided)
   (i) Storage for clean and sterile goods
   (ii) Loading area
   (iii) Circulation space necessary for the above accommodation.

Functional unit

42. The functional unit selected for the basic accommodation in this Note and the related cost note (Appendix E to Building Note No. 2) is the theatre.

(B) Additional accommodation

43. (*a*) Theatre(s) for specialised branches of surgery
   (*b*) Monitoring room(s)
   (*c*) Trolley store or waiting space
   (*d*) Laboratory
   (*e*) Anaesthetists' office
   (*f*) Endoscopy room
   (*g*) Plaster room
   (*h*) Workshop (surgical and anaesthetic)
   (*i*) Room for cleansing and sterilising bulky equipment.

4 Description of rooms

44. The recommended areas for rooms in the basic accommodation are given in the table in Appendix I. A comprehensive list of equipment required in an operating department will be detailed in a Hospital Equipment Note. The equipment described in this Note is included merely as a guide in the planning and space requirements and is not intended to be a complete list.

(A) Basic accommodation

(a) Theatre suites and related rooms

(i) *Entrance and porters' station*

45. All patients, staff and supplies will enter the department at this point; the possible exception is clean supplies, which may in certain designs go direct to the theatre sterilisation and supply unit. Double doors should be provided to lead from the main hospital corridor. The approaches to the staff changing rooms, the recovery area, the reception and transfer areas and in most cases the T.S.S.U. should lead off from this main entrance. A porters' station or clerk's office will be required.

(ii) *Reception/transfer area* (See Figure 5)

46. The purpose of this area will be to receive patients from the wards, and to provide space for the eventual transfer of each patient from the ward bed or trolley to the theatre trolley before entry to the theatre. Patients leaving the department, either via the recovery area or directly from the theatre, will pass through the 'transfer zone' of this area (unless a special 'exit transfer zone' is provided). It is, therefore, to be regarded as a lobby between the entrance to the department, or 'outer' corridor, and the 'clean' corridor.

47. The reception area will consist of space for parking beds or trolleys together with the necessary circulation. An area of about 70 sq ft per bed within the curtaining (if provided), plus circulation, should meet both needs. Ancillary rooms will be shared with the post-operative recovery area to which the labelled beds will in turn be wheeled to await the patients' return.

48. Space will also be required for a 'transfer zone' where the patient will normally be transferred from his ward bed or trolley to the clean theatre trolley for transport to the anaesthetic room. This zone acts as an airlock and an area of about 200 sq ft within it is necessary to accommodate the two vehicles and four staff. There should be clear demarcation on the floor, e.g. by the use of a coloured floor finish or physical barrier (such as a curb or rail) which allows the patient to be moved from the 'ward' transport to the 'theatre' transport, while reminding staff that only those who have changed into theatre clothes and over-shoes may proceed beyond this point.

49. The actual 'transfer zone' should preferably be located on the 'clean' corridor side of the reception/recovery areas. If so positioned (Figure 5a) the patient can remain in his ward bed in the reception and recovery area and ward staff can enter this area. The surgeon or anaesthetist can, if necessary, visit the patient in these areas, but would require to change his gown and footwear before returning to the clean zone. If the 'transfer zone' is on the ward corridor side (Figure 5b) the following disadvantages result:

(1) Extra bed parking space will be needed. This area will have to be sufficiently large to allow for the ready extraction of any bed, not necessarily in the order of arrival.

(2) This additional area would require extra staff during theatre sessions so that any bed can be produced at any time and these staff can assist in the transferring of the patient.

(3) Additional trolleys (suitable to be used for the post-operative period) will be required. (Though the reception/recovery is planned on the clean side of the transfer zone area it is not as clean as the anaesthetic rooms and theatres.) This also involves extra lifting of the patient.

(4) The rate of early-morning patient arrivals might cause a bottleneck at the transfer zone. If the reception area precedes the transfer zone in the traffic flow this would not occur.

(5) A false sense of security may be engendered in the reception/recovery area because it is on the 'clean' side of the transfer zone.

(6) Full changing accommodation would have to be provided for the staff serving the reception/recovery area. If this area is on the 'outer' corridor side of the transfer zone a nurses' w.c. and lavatory basin only will be required.

The balance of advantages lies therefore in planning the 'transfer zone' on the 'clean corridor' side, and also, since beds could be taken into the reception/recovery areas, this minimises the number of times the patient needs to be transferred from one vehicle to another.

(iii) *Changing rooms* (*and sanitary facilities*) (See Figure 6)

50. In these rooms the staff will change from everyday uniform or day clothes into theatre garb, including overboots, though the operating team will proceed to the scrub-up before donning sterile gowns,

etc. Staff entering the department should follow a sequence from 'dirty' to 'clean' areas arranged so that unchanged staff have no contact with those who have changed. The layout should also offer an acceptable standard of privacy to staff in their progress through the sequence. Lavatories should be accessible only from the 'unchanged' end of the sequence. The layout should also reflect the need to supply and dispose of towels, theatre clothes, etc. The area provided should be based on an allowance of changing and locker space of 12 sq ft per person employed in the theatres during one session. Sanitary facilities will be dependent on the number of staff. As a rough guide a ratio of about one w.c., one lavatory basin and one shower between 8–12 people should be adequate.

51. Doors will be required from the outer corridor and the clean corridor to each changing room and from the changing room to the sanitary facilities associated with it in each case. Each changing room should be provided with individual full-length hanging space and shoe rail for each member using the room. Bench seating and some upright chairs, and looking glasses should also be provided. The shower cubicles should be large enough for people to dry themselves inside.

(iv) *Rest rooms*

52. Rest rooms are required for (1) medical staff, (2) nursing staff, (3) theatre attendants and orderlies. It will be to these rooms that members of the staff can retire between and after operating sessions. The numbers of nursing staff will be larger than those of other categories, and the question of size for the nurses' rest room should be carefully considered. Normally, the sizes of the rooms should vary between 150 sq ft and 250 sq ft for the medical and nursing rest rooms, depending on the number of theatres included in the department. On the same principle the rest room for attendants and orderlies should be between 100 and 150 sq ft. The rest rooms should preferably be planned close to the staff changing rooms and to the tea pantry. They should be equipped with doors from the clean corridor and with windows, if possible, though since the rest rooms are in the 'clean' area of the department planning considerations may render this impracticable. Each rest room should be equipped with bookcase, chairs, low table, small writing table, and power socket outlet, and provision should be specifically made in the medical staff room for the recording of notes.

(v) *Office for theatre superintendent*

(vi) *Office for theatre sisters* (where appropriate)

53. These rooms may be planned near the entrance and the reception/transfer area, but it must be possible for anyone within the clean area of the department to enter the offices without changing from theatre clothing. The minimum size should be 120 sq ft, and each office should be supplied with a desk or writing-top with cupboards under, chairs, low table, notice-board and telephone. Access to the offices should be by means of a door opening from the clean corridor.

(vii) *Scrub-up and gowning area*

54. Normally one scrub-up room should be provided to each theatre to enable operating staff to scrub-up, mask and put on operating gowns and rubber gloves. The minimum size should be 100 sq ft for each room, and single doors should be provided to the clean corridor and the theatre.

55. There should be a door between the theatre and the scrub-up room. It is an advantage to have a glazed panel in the wall between the theatre and the associated scrub-up so that staff can see what is going on in the theatre while they are scrubbing-up. The room should be provided with two or three splash-screened scrub-up stalls. The necessary supply of sterile gowns, gloves and masks for the session should be stored here.

(viii) *Theatre preparation room*

56. One of these rooms should be provided to each theatre. In this room the trolleys from the T.S.S.U. or sterile store, with the required sterile packs, fluids, etc., are held and their preparation completed immediately prior to the operation. A small supply of emergency packs, and spare wrapped sterile instruments, fluids and miscellanenous items will be kept in the theatre preparation room. It should be unnecessary to install facilities in theatre preparation rooms for emergency re-sterilisation of dropped instruments, etc. The room should be a minimum of 120 sq ft in area and be equipped with high level storage shelves, and a heated cupboard for storing sterile water at correct temperature.

(ix) *Anaesthetic room*

57. Although the main purpose of this room is to provide a suitable environment for the induction of anaesthesia, in some hospitals it may also be used to transfer patients from the trolley to the operating table. The room should be of a minimum size of 180 sq ft and a minimum width of 10 ft if built-in equipment is provided on one side of the room only, or 11 ft 6 in if built-in equipment lines two sides; but it is particularly important that the shape of the room should be decided by study of the work and movements to be conducted in it. Double doors are required from the clean corridor and to the theatre, the doors opening in the direction of movement of the patient, i.e. inwards to the anaesthetic room from the corridor and outwards to the theatre. A sink and drainer, worktop, high level cupboard (for the storage of anaesthetics, drugs, instruments and materials), a writing desk or shelf, and piped supplies of anaesthetic gases and a suction point will be required. Space for storage of special gas cylinders may also be needed, together with the anaesthetists's trolley and stool, and space for the patient's trolley. A light signal over the entrance doors to this room and/or viewing panel is required to indicate when an anaesthetic is being given.

(x) *Operating theatre*

58. Apart from the conduct of operations, plasters may be applied in the theatre itself after orthopaedic operations. The minimum size of the theatre should be 400 sq ft, though larger theatres may be required for certain specialties, and in a district general hospital one theatre should be at least 480 sq ft. The minimum ceiling height should be 10 ft to allow adequate mobility of the centre light fitting. Windows are not essential, and although there may well be a desire to provide natural lighting for the theatres this may be difficult to achieve without sacrificing important planning principles (e.g. as illustrated in Figures 4(a)–(e)). Double doors should lead from the anaesthetic room and to the exit lobby. A single door to the theatre preparation room and one each

to the disposal area and to the scrub-up (see paragraphs 54 and 55) will be needed. The theatre should be provided with an operating table, an adjustable centre light fitting, an x-ray viewing screen to hold at least two films, and a piped supply of gases and suction. Equipment which may be brought into the theatre includes mobile x-ray apparatus, instrument trolleys, diathermy apparatus, a swab rack, containers for used swabs and soiled instruments, and the anaesthetist's trolley.

(xi) *Exit lobby*

59. Each exit lobby can be shared between two theatres though with some designs a separate lobby for each theatre may be preferred. The function of the lobby is to provide an exit route for patients and staff, and a space for transferring patients from the theatre table to the trolley if this is the hospital practice. The minimum width should be 8 ft in the clear (i.e. unobstructed by doors) and the shape should be such as to allow patients to be transferred from table to trolley if need be. There should be double doors opening outward from the theatre.

(xii) *Disposal and cleaning area* (See Figures 4)

60. This area may be an unenclosed space of a minimum of 50 sq ft immediately outside the door leading from the theatre to the disposal corridor. Its function is to permit large items of equipment which will shortly be required again to be cleaned, and to accommodate equipment for the immediate cleaning of the theatre after each case. The area will generally be open to the disposal corridor, but should be provided with a single door leading from the theatre. A large sink and drainer or worktop will be required with space for dirty linen and waste containers.

(xiii) *Disposal corridor* (See Figures 3)

61. This corridor is the connecting link between the theatres and the T.S.S.U. for all used materials; it is also the exit route for all used materials being returned to the C.S.S.D. (whether at the hospital or at some other hospital), for the laundry and for disposal of items to be destroyed in the hospital incinertors or by other means. The route taken by material from the theatre to be processed in the T.S.S.U. or C.S.S.D. will be via the disposal and cleansing area to the end of the disposal corridor nearest to the 'receiving and cleaning' section of the T.S.S.U. or C.S.S.D. Here the disposal corridor should constitute a sorting lobby in which staff will strip the trolleys, holding linen until instruments have been checked, despatching dirty instruments and unused dressings to the T.S.S.U. or C.S.S.D. and dirty linen and material for disposal through a separate exit to the laundry, incinerators, etc. Doors (or hoists as appropriate) will be required to the T.S.S.U. or C.S.S.D. and to the exit for goods being sent direct for destruction, laundry and C.S.S.D. where this is remote from the department. A small storage space for floor cleaning equipment, etc., for the disposal areas should be provided adjacent to this corridor. Lavatory accommodation for staff working in the disposal corridor and the 'receiving and cleaning' area of the T.S.S.U. where provided should open either from the corridor itself or from the T.S.S.U. A width of 5 ft in the clear for the corridor should be adequate. The corridor will be mechanically ventilated and therefore a lobby forming an airlock must be provided at the exit.

(xiv) *Stores*

62. A store for equipment (e.g. sandbags or other forms of support, parts of tables, etc.) which may be needed frequently and at short notice during operations should be provided close to each theatre (the size of the store should be about 2 ft deep by 5 ft wide). The store should open to the exit lobby and, if this is practicable, it should have access to and from the anaesthetic room. Other bulky equipment, the need for which can usually be foreseen, should be stored in a central storeroom serving all theatres and opening on to the clean corridor (size, a minimum of 150 sq ft). This central store should be provided with a shelf at not more than 5 ft 6 in from the floor.

63. Linen (sheets, blankets, etc.) for use in the recovery area should be kept adjacent to the nurses' station in a cupboard; for the transfer zone, in a garage cupboard for a linen trolley; and for staff changing, in a small sorting and stock cupboard opening from the clean corridor and serving all staff changing rooms. Caps, gowns, masks, towels, drapes, topical fluids, etc., from the pharmacy or C.S.S.D. for use in the theatre should be stored in T.S.S.U. or sterile store with the packs from the C.S.S.D.

(xv) *Store for mobile x-ray*

64. Mobile x-ray apparatus should not be stored in the central storage space referred to above, but in a separate store or alcove opening from the clean corridor at a point from which the mobile x-ray apparatus can be easily obtained for use in any of the theatres. The size of the mobile x-ray store will depend on the number and sizes of apparatus commonly used in individual hospitals. A socket outlet should be provided.

(xvi) *Darkroom*

65. A simple darkroom should be provided off the clean corridor and equipped with a water supply and sink and drainer facilities.

(xvii) *Tea pantry*

66. This room or alcove will be used for making hot and cold drinks, and possibly light snacks, for the theatre staff. It should be planned off the clean corridor and close to the staff rest rooms – possibly with direct access to the nurses' rest room. It should be equipped with a small sink and draining board, electric kettle, boiling ring, a cupboard for crockery, cutlery and dry goods, and a worktop with space under for a trolley.

(xviii) *Recovery area* (See Figure 5)

67. This area will accommodate patients who have emerged from the operating theatre and are awaiting transit to an intensive therapy unit or one of the wards. The length of stay of each patient in the recovery area will vary according to the practice adopted at individual hospitals, but will generally not exceed 30 minutes. In some instances it may be preferable for certain patients to be sent direct to an intensive therapy unit from the theatre or, more rarely, direct to the wards.

68. The advantages of planning the recovery area in close relation to the reception/transfer area are:

(*a*) The patient's bed or trolley on which he arrived from the ward can be readily transferred from the reception to the recovery area.

(*b*) The nursing staff serving the reception and transfer areas will be able to move through to

the recovery area as the day passes and more patients return from the theatres.

(*c*) Both areas can share the services of a senior member of the nursing staff.

(*d*) Both areas require similar ancillary (e.g. supply) rooms and it is more economical for these to be shared.

69. An allowance of 100 sq ft per bed should be provided, and the number of beds should be calculated on the basis of one-and-a-half beds per theatre in the department.

70. Double doors should be provided wherever beds or trolleys will be wheeled through. Although planning considerations may make it difficult to provide natural daylight through windows, these should be provided where possible. The room will be mechanically ventilated to maintain a suitable air flow from the clean corridor zone to the outer corridor zone. The room should be provided with piped oxygen and suction.

(xix) *Ancillary rooms (clean and dirty utility) for recovery room and reception/transfer area*

71. A combined nurses' station and clean utility area should be provided for the preparation and storage of materials required for patients using the reception area and recovery room. It should be so located as to be easily accessible to nursing staff without obstruction. The area should comprise about 80–100 sq ft and be equipped with open adjustable shelves for packs, lotions, etc., and for storing linen; with a worktop, space for parking trolleys; lavatory basin(s) with wrist-operated taps and a supply of drinking water, and a drug cupboard and medicine trolley (stored in a garage cupboard or with self-locking top).

72. A dirty utility room should be provided with an area of about 100 sq ft, with access from the recovery room and, where the facilities are to be shared with the reception/transfer area, from that area also. In this room dirty or used goods can be cleaned and stored temporarily pending disposal or transfer to the C.S.S.D. laundry, etc. Facilities for emptying the occasional bedpan, etc., should be provided. The room will require a worktop, a small sink with wrist-operated taps and drainer, disposal bins and stands for soiled linen.

(xx) *Cleaners' room*

73. Cleaning equipment for the immediate cleansing of theatres after each operation will be kept in each disposal area (see paragraph 60). This equipment should be separately provided for each theatre and used by the theatre orderlies.

74. A central cleaners' storeroom should be provided for the equipment used by the domestic staff when they clean the theatres at the end of each day. This store should open off the clean corridor and should preferably be located near the domestic staff changing room. Supplies for this room (detergents, etc.) will be issued from the central supply department of the hospital through the main entrance to the theatre suite. The room should be about 100 sq ft in area. It will need a bucket sink with hot and cold water, drainer, and space for mechanical cleaning equipment, cleaning utensils, etc. Facilities for cleaning theatre boots are required centrally, either in a defined area of the cleaners' storeroom or separately. The basic requirements for such an area will be a sink, drainer and rack.

(xxi) *Plant room(s)*

75. Plant rooms are required to house plant for mechanical ventilation, switch-gear and electrical distribution, batteries and emergency lighting plant. The numbers of plant rooms provided will depend upon the layout of the department, but it is generally more economical to have one plant room serving several theatres. The essential planning considerations are that engineering service runs should be kept as short as possible and noise transmission from plant kept to the minimum. There are advantages also in grouping the calorifiers apart from other engineering plant, but normally there will not be separate calorifiers for the department. The plant rooms should permit easy access for maintenance, and those for ventilation be located conveniently in relation to the fresh air intake.

76. The size of the room or rooms depends on the number and nature of the actual plant accommodated. As a guide the following areas are suggested: four theatres 800 sq ft, eight theatres 1,400 sq ft.

77. Independent access to plant rooms should be provided from a corridor, and door openings should be dimensioned according to the requirements for installation of new machinery and the ingress of gas storage cylinders, etc. Lifting facilities may be needed in the shape of overhead R.S.J. for the removal of calorifier steam chests, etc. Ventilation should be provided by permanent louvres in the walls and doors. Natural daylight is not essential. Openable windows or openable glass louvres may be desirable to prevent build-up of heat within the room. Plant rooms may be equipped with a small compressor and receiver if compressed air is being piped to the theatres; with water, steam and electricity services and a vacuum pump for the medical suction installation in each theatre.

(xxii) *Circulation space*

78. The clean corridor should be free of projections and have a minimum width of 8 ft exclusive of opening doors, parked trolleys, etc., to allow ample space for staff wheeling patients on trolleys to pass. Subsidiary corridors can be narrower to suit particular requirements but in general 5 ft is recommended as the minimum corridor width.

(*b*) ***Theatre sterile supply unit*** (*T.S.S.U.*) for departments with no nearby C.S.S.D. (See Figure 2 and paragraph 24)

79. The functions of this unit are as follows:

(i) Receiving and cleaning after an operation all non-disposable instruments, bowls, theatre trolleys and trays which have been returned from the theatre.

(ii) Examining and storing cleaned articles.

(iii) Packing clean instruments and bowls before sterilisation or preparation of pre-set trolley top trays.

(iv) Sterilising these packs or trays in autoclaves (including, where considered necessary, flash sterilisation of instruments in an emergency – see footnote to table, paragraph 178).

(v) Storing the sterilised packs or trays from T.S.S.U. and from C.S.S.D., and items from laundry and pharmacy (including bottled fluids).

(vi) Loading the clean trolleys with sterile packs (or trays if pre-set trolley top trays are in use) of instruments, etc., packs from the C.S.S.D.,

bottled fluids, etc. Despatching the loaded trolleys to each theatre preparation room.

(vii) Receipt of goods from C.S.S.D., laundry and pharmacy, and removal of outer wrappings, where necessary, prior to storage.

80. So long as provision is made for the discharge of all these functions, the planning of the unit and its division into separate rooms or areas will be largely dependent on the organisation of the work. Figure 2 illustrates diagramatically the relationship between each function and the space to be provided in the T.S.S.U. and also indicates a schematic traffic flow. The need to maintain a service during re-decoration of the unit should be borne in mind in the detailed planning.

81. It is important to observe that the 'receiving and cleaning' area of the T.S.S.U. is directly adjacent to, and has access to, the disposal corridor. From this receiving and cleaning area the storing and sterilising areas lead to the sterile zone of the department. Careful attention must therefore be given to minimising the risks of cross-infection which this sequence creates, and consideration will have to be given to separating the receiving, cleaning and packing area from the rest of the unit by means of some physical barrier such as a glazed partition: it will also be necessary to require strict discipline of staff using and working in the receiving and cleaning area, so that traffic between this area and the rest of the unit is kept to an absolute minimum.

82. The areas appropriate to the T.S.S.U. are given in the table in Appendix I.

(c) Sterile store

83. Where no T.S.S.U. is included in the department (i.e. where the function of the T.S.S.U. is to be discharged in a nearby C.S.S.D.) a sterile store will be required to accommodate sterile supplies and instruments received from the C.S.S.D. The store should open on to the 'clean' corridor and supplies should be received within it direct from the C.S.S.D. Stocks of sterile supplies and instruments should be kept here and used for laying up trolleys before despatch to individual theatre preparation rooms. Appropriate shelving, cupboards, racks and space for trolleys will be required. Suggested sizes are given in the table at Appendix I.

(B) Additional accommodation

(a) Theatre(s) for specialised branches of surgery

84. Dependent on the nature of the work carried out at individual hospitals it may be desirable to allocate one or more theatres to a certain specialty or specialties, and to design the theatre for the particular needs to be met, rather than as a general surgery theatre. For example, theatres for certain specialties may require to be of a larger area if more than the usual amount of equipment is required. A special case should be made for each particular size and type of theatre.

(b) Monitoring room(s)

85. There may be a need for monitoring room(s) in some hospitals where the nature of the surgical work carried out justifies this: the primary function of the room is to house the equipment and its attendant operator, but the space also enables staff interested in particular cases to follow and, where necessary, advise on the conduct of the operation. Information about the condition of the patient is transferred directly from the patient to the electronic equipment in the monitoring room. There is not yet sufficient experience upon which to make firm recommendations about the planning of accommodation for monitoring equipment, but one solution is to have a room next to the theatre it is serving with a fixed glazed panel between the rooms. If the room is planned between two theatres it can conveniently serve either one or the other, or both at the same time. A room of about 120 sq ft is adequate for the equipment necessary for one theatre, writing desk, a space for technicians and for two or three other staff to watch the closed circuit television, or the operation itself through the glazed panel. An additional area of about 60 sq ft (for a further technician and additional equipment, or for a larger desk unit having two operator control positions) will be required where the room serves two theatres simultaneously. A pair of double doors to the clean corridor should be provided to permit the initial installation of the central recording desk (dimensions approximately 6 ft × 3 ft × 4 ft). A fair amount of heat is generated by the electronic equipment in the room and good ventilation will be required.

(c) Trolley store or waiting space

86. Additional parking space may be needed for beds or trolleys, depending on the position and size of the reception/transfer areas and the hospital methods for transporting patients from the ward to the theatres. Such space may be provided either outside the entrance to the theatre, or immediately inside the entrance to the theatres. An area of approximately 3 ft × 7 ft should be allowed for each trolley or bed to be parked.

(d) Laboratory

87. Where the type of work done in the operating theatres requires laboratory services and the main laboratories are so located that rapid transmission and examination of specimens is not practicable, it may be desirable to provide a small laboratory within the theatre suite itself. The room should be designed as a simple laboratory primarily equipped for microscopic examination of tissues or smears taken during the course of an operation though it could also be used for other types of examination, e.g. simple chemical estimations. It should be of approximately 60 sq ft in area. A door should be provided opening to the outer corridor so that the laboratory technicians can enter and leave the room without passing through the clean area. It will often be necessary for the pathologist to enter the theatre itself but provision should also be made for surgeons to converse with the pathologist by telephone or inter-com from the theatre to the main pathology department. There is a considerable body of opinion against having a subsidiary laboratory in the theatre on the grounds that the main laboratories should always be used. This arrangement is generally satisfactory if there is provision for the rapid transfer of specimens from theatres to laboratories.

(e) Anaesthetists' office

88. In large hospitals where several anaesthetists are likely to be employed, it will be necessary for office accommodation to be provided for them. Generally there are advantages in locating this with an intensive therapy unit but in certain circumstances it could be planned as part of the operating department, and

where this is done it should open off the outer corridor. An area of approximately 150 sq ft is suggested where the room is habitually used by more than two people. The number of rooms will depend on the pattern of staffing at the hospital.

(*f*) *Endoscopy room*

89. The need for this room will depend on the nature and extent of facilities for endoscopy in other parts of the hospital (for example, in treatment rooms in wards or in treatment rooms or operating theatres in the out-patient department). Where provided the room should be of approximately 180 sq ft and planned on similar lines to a treatment room, and be planned adjacent to the theatres with access to the clean corridor. The ventilation may be taken from the main ventilation system where convenient.

(*g*) *Plaster room*

90. This room will not usually be required, since most of the plaster work will be undertaken in the out-patient department or fracture clinic in the accident and emergency department. Again, where plasters are required in association with the operative treatment of in-patients the plaster will, in most cases, be applied in the theatre itself. Where, exceptionally, a plaster room is considered essential (for example, to service an accident and emergency theatre in the main operating department) it might be of about 250 sq ft in area. It should be of a minimum height of 10 ft so that suspension equipment can be used while plaster jackets, etc., are applied – the ceiling structure should be strong enough to carry the weight of this equipment and of the patients using it. The room should be provided with a single door to the disposal corridor and double doors to the clean corridors. Mechanical ventilation with balanced input and extract will be required. A filter behind the extract grille is desirable to prevent dust from entering the duct. The floor will require frequent washing, so that an impervious finish is required with falls to a gulley and plaster trap.

(*h*) *Workshop* (*surgical and anaesthetic*)

91. It is desirable that minor repairs and maintenance to, for example, anaesthetic machines, electronic equipment, suction apparatus, etc., should be done within the department, to avoid the risk of damage to delicate apparatus inherent in transit to and from the main hospital workshop. A small workshop may be required to accommodate these functions. It should preferably lead off the outer corridor so that maintenance staff can service the equipment without changing their clothes. It should be fitted with a work bench with socket outlets for testing electronic equipment, and with shelves or cupboards for items waiting to be repaired and drawers for tools. An area of about 100 sq ft should suffice.

(*i*) *Room for cleansing and sterilising bulky equipment*

92. In certain units, e.g. where cardiac surgery is undertaken, it will probably be desirable to have one room reserved specially for cleansing and sterilising equipment such as heart lung machines, hypothermia apparatus, etc. The heart lung machines must be stripped, washed and sterilised after each period of use. The room should contain a sink and draining board, the sink having internal dimensions of at least 2 ft 9 in long by about 10 in deep. The room should have access to the clean corridor and should be of a minimum area of 200 sq ft, the actual size being dependent on the amount of elaborate or bulky equipment processed in the room.

Illustration of relationship between spaces in the department

93. The description of the functioning of the rooms in the department given in Parts 2 and 4 of this Note indicates that the problem of reconciling the various functions and operational requirements is not an easy one. Some suggestions on possible layouts are given in the following figures:

Figure 3 illustrates a number of ways of grouping the T.S.S.U. and the theatre suites, i.e. the operating theatre itself and its immediate associates such as anaesthetic room, scrub-up, theatre preparation room, exit lobby and disposal area.

Figures 4(*a*)–(*e*) illustrate some ways of laying out the theatre suite (as defined above) itself so as to observe the traffic and ventilation requirements discussed in Parts 2 and 4 and in the Engineering Section, Part 5, of this Note. It should be noted that these figures are drawn to 1/16 in. scale in relation to the room sizes recommended in Part 4 and in the Schedule of Accommodation Table in Appendix 1, in order to demonstrate how the separate areas can be grouped to form one theatre suite.

Anti-static precautions

94. Anti-static floors (see Hospital Technical Memorandum No. 2: Anti-static Precautions: Flooring in Anaesthetising Areas) should be provided in rooms in which anaesthetic apparatus is used and in any corridor traversed by a patient being transported from one anaesthetising area to another while connected to the anaesthetic apparatus. Anti-static floors will, in consequence, normally be required in the anaesthetic room, the operating theatre, plaster room, endoscopy rooms and possibly the recovery area. The anti-static floor covering should extend to the walls of each room or to at least 6 ft around any position where anaesthetic apparatus may be used. Similarly, the equipment to be used in these areas should comply with the recommendations laid down in Hospital Technical Memorandum No. 1: Anti-static Precautions: Rubber, Plastics and Fabrics.

5 Engineering services

95. The design of the engineering services should allow easy access to the parts requiring regular attention so that cleaning, maintenance and repairs can be carried out as far as possible without entering the sterile and clean areas of the department. It is essential that equipment is serviced and grilles are cleaned frequently and it is necessary therefore that there should be agreed arrangements for the work to be done at times which are convenient to the maintenance department and the needs of planned preventive maintenance.

Mechanical services

Heating and ventilation

General

96. The layout of the department and its position within the hospital will determine whether the whole of it should be mechanically ventilated. For a compact plan such as that diagrammatically illustrated in Figure 1 (a) this will probably be necessary, except that the staff changing and rest rooms might have natural ventilation. Even so, open windows in these rooms and in corridors may affect air movement in the clean and sterile zones of the department undesirably.

97. The type of ventilating system and the desirable number of ventilating plants are matters for the design engineer. It is probable that the most satisfactory solution would be to have a number of plants, e.g. one for every two theatre suites; one for the recovery and reception areas; one for staff changing areas and one for the T.S.S.U. These should be sited in one, or preferably two, centrally placed plant rooms. Spare motors should be provided, but apart from this no provision for stand-by plant can normally be justified. If one plant is provided for the whole department and stand-by plant thus rendered essential the total cost of this arrangement would be greater than that of the several plants without stand-by. Dual duct high velocity systems have advantages but are more costly and would not normally be used except where the department is part of an air conditioned hospital served by such a system. The inclusion of sound absorption devices must not give rise to the risk of fibrous particles being released into the air stream. The fans should be switched off when no one is in the department, and for night and weekend working when one or two theatres need to be used for emergency operations the flexibility provided by a number of plants makes for economy in running costs.

98. The report in 1962 to the Medical Research Council on the 'Design and Ventilation of Operating Room Suites for the control of Infection and for Comfort' is a valuable guide to designers. The following remarks underline what is said in this report or are on parallel lines.

99. The design and operation of the ventilation systems should ensure an airflow pattern from sterile zones to less clean zones throughout the theatre department without undue risk of counter-flow. Quietness of operation is essential.

100. In commercial buildings where air conditioning is provided there are advantages in the use of re-circulated air, but in hospital patient areas and particularly operating theatres, re-circulation of air is not acceptable: a risk could exist of re-circulating pathogenic bacteria through imperfect filters and frames, and in theatre suites a re-circulation system could cause interference with the desirable airflow pattern between the rooms. Present practice requires that the air supply to the theatre suite should be 100 per cent fresh air.

101. A temperature within the range of 65/70°F (18/21°C) is usually acceptable in the theatres though some surgeons prefer 70/75°F (21/24°C). In the theatres and anaesthetic rooms a relative humidity of not less than 50 per cent should be maintained to reduce the build-up of electro-static charges.

102. Radiant heat and high humidity together produce discomfort at higher temperatures. This condition may be experienced in the T.S.S.U. unless there is adequate air movement.

103. The importance of careful layout and design to avoid heat gains from plant and pipes and consequent temperature rise in the theatres cannot be overstressed, e.g. the removal of sterilising equipment from the vicinity of the theatres as recommended in this Building Note (see paragraph 3(*b*)). Departments should not be located over calorifier rooms or other major sources of heat. Heated floors, apart from impairing comfort, cause potentially dirty air currents to rise and tend to be less effective in neutralizing electro-static charges. The provision of refrigerated air conditioning alone is not an insurance against discomfort.

104. All relevant factors, e.g. unavoidable heat gains, geographical location, building layout, form of construction, must be carefully considered to determine whether the supply of fresh air can satisfactorily offset the heat gains or whether the high incidence of hot weather in the area would justify the introduction of a system of cooling for summer use.

105. 'Full air conditioning' is understood to mean that temperatures and humidities within the theatre

will be maintained at 70°F and 60 per cent R.H. with outside conditions as specified for the basis of design in the Institution of Heating and Ventilating Engineers Guide, e.g. for London 82°F dry bulb and 66°F wet bulb. On the very few occasions when the shade temperature is hotter than 82°F, the wet bulb temperature is often lower than 66°F and inside temperatures could still probably be maintained at 70°F or only slightly higher. It is also the case that there is a sense of chill on entering an area where temperatures are much more than 10°F cooler than outside the area.

106. 'Full air conditioning' may be required for some special theatres, e.g. cardiac and neurosurgery, but the first requirement in most other schemes is to remove heat gains so that internal summer temperatures are not higher than external shade temperatures, subject, of course, to the maintenance of minimum internal temperatures of 65°–75°F as desired. The second requirement is to consider whether internal temperatures need to be much lower than the external shade temperatures which normally occur in the summer in that part of the country. For example, in Glasgow the basis of design for air conditioning is an external temperature of 76°F dry bulb with 64°F wet bulb and the amount of cooling need not be great. (See paragraph 152 *et seq.*)

107. Personal requirements for comfort vary to a great extent: nevertheless it should be possible for the theatre staff to select the temperature required for the patients' benefit and for the comfort of the operating team, and the thermostats and ventilating system should be capable of achieving and maintaining this condition, within the limits of the design.

Air distribution in the theatre

108. A supply of air at approximately 1,000/1,200 cu ft per minute provides satisfactory pressurisation of the theatre, and is enough to prevent ingress of air from adjacent rooms and corridors. The air should be introduced at low velocities to minimise noise and draught and should find its own way out from the theatre through one or two low-level balanced flap outlet(s) to a natural discharge duct, and under the doors.

109. Studies on ways of introducing air into the theatre to obtain optimum comfort and removal of bacteria are being carried out, but at present there is no generally accepted best method. The best advice on the subject is set out in the Report to the Medical Research Council referred to above. The relevant extract is as follows:

> 'The simplest way . . . is to introduce air through high level grilles arranged to produce general air turbulence throughout the room, with an air velocity of about 40 ft per minute in the centre. The advantages of this system are that bacteria liberated in the immediate vicinity of the operating table are rapidly dispersed and that reasonably vigorous air movement is more comfortable when temperature and humidity are high. But this air movement has the disadvantage that some of the organisms liberated near the floor or at the periphery of the room are carried into the operation zone. An alternative method of ventilation is to introduce air through several diffusers distributed over the ceiling so as to cause low turbulence downward-displacement of air over the whole area of the room. The turbulent air velocities in the centre of the room are then about 10 ft per minute. To create such a "piston" effect the air must be able to escape from the room through low level ports distributed round the periphery. The piston effect is greatest when the room is being ventilated with warm air in cold weather; it is reduced but still appreciable when cool air is being introduced in hot weather. The advantages of displacement ventilation are that airborne organisms are cleared from the room more rapidly than by the "turbulent" system; that organisms liberated near or from the floor at the periphery of the room are swept out with little contamination of the operation zone; and that under some conditions it can maintain a lower air temperature in the room than does the turbulent system. The performance of this system is generally not significantly affected by the heat of the lamp over the table; considerable movement by nurses and other staff will, however, tend to create turbulent air movement and to break up the piston effect. The low air velocity in the centre of the room has the disadvantage that organisms liberated near the wound are only slowly dispersed before being carried out of the room. Opinions are divided on the relative advantages and disadvantages of these two systems, and on the difficulties of maintaining the displacement conditions. Trials of both are in progress which it is hoped will decide these questions. There is no doubt, however, that both systems can produce good results. . . .
>
> 'Various methods of delivering a local supply of clean air to the operation area have been suggested but there is not yet evidence that they have any advantage over the two methods described above.'

110. Since the report of the Medical Research Council's Operating Theatre Hygiene Sub-Committee was published in 1962, however, it has become apparent that unless temperature control is very good, an air velocity of 40 ft per minute may give rise to uncomfortable cooling and that a velocity of 30 ft per minute is more desirable. The trials of the two systems for introducing air into operating theatres have not yet been concluded, but the information available indicates that it is more difficult to achieve a satisfactory downward displacement system than was originally supposed.

111. The grilles and/or diffusers referred to should be of the adjustable type and easily removable for cleaning. Where the turbulent system of ventilation is employed the vanes should be set to give a core of clean air between the lamp and the table. Not less than four should be installed and the 'leaving' velocity must be carefully selected so that the 'throw' will be about 4–5 ft and create a steady airflow downwards or across the room. The air entrained by the diffusers or grilles should provide a turbulent air curtain near the perimeter of the theatre and thus help to reduce the tendency for swirling air currents to rise from the floor around the operating table, as a consequence of staff movements. Diagrams to illustrate the pattern of airflow for the various combinations of rooms which constitute the department, are shown in Figure 7.

General air movement in the department

(Figures 7 and 8)

112. Air distribution should be from the operating theatre and the preparation room progressively through the clean area, towards the protective zone, except where there is a known risk of the dispersal of infective material.

113. Mechanical extraction should be used to remove the air flow level from the disposal corridor, the anaesthetic room (because of the presence of gases) and the outer corridor near the reception/transfer area point though it is essential that this should not affect the maintenance of a positive pressure in the theatres and preparation rooms. Mechanical extract is not necessary in the theatre, preparation room, the scrub-up room, or the exit lobby; leakage past the doors should be sufficient, but a small balanced flap valve may be installed to assure the required flow of air from these areas. The scrub-up area is only used intermittently and can be regarded as an intermediate clean area, through which the air from the theatre may pass towards the corridor discharge point when doors are open.

114. A separate airflow to each preparation room should be designed so that it is in balance with the air pressures in the theatre served by the room. This arrangement should establish a sufficient pressure differential to ensure an airflow towards the less clean areas, and eliminate the risk of counter-flow at doorways arising from differences in temperature.

115. The functioning of the theatre sterile supply unit within the department dictates the need for mechanical ventilation. The requirement is to provide clean, comfortable working conditions in the unit: the main problem being in the region of the sterilisers. The number of air changes and the degree of cooling required will depend on the individual design but not less than an average of six fresh changes per hour is necessary to maintain an acceptably clean atmosphere. The direction of airflow should be from the clean to the less clean areas.

116. Sterilisers, steam and condensate piping, valves, etc., must be carefully and efficiently lagged and the rear chamber for these sterilisers should be adequately ventilated.

117. For the anaesthetic room it is suggested the air supply should come partly from the theatre and partly be fresh air at 250/300 cu ft per minute. Mechanical extract would be at the rate of 400 cu ft per minute.

118. In the recovery and reception areas, the aim is to provide clean, comfortable conditions having regard to the pattern of air movement within the department as a whole. The number of air changes will depend on the design but a minimum of six fresh air changes per hour is desirable to maintain a general cleanliness of atmosphere.

119. It may be noted that the amount of air leakage through door joints, with a gap of approximately ⅜ in. between the floor and the bottom of otherwise well fitted doors, can amount to as much as 40 per cent of the air supply to the operating room. This leakage is an acceptable feature of the installation and contributes to the reduction of airflow noise created by the pressurised conditions in the theatre.

120. The external discharge to the open air from the main discharge duct via a balanced flap outlet valve should be protected against direct wind pressure as a 'through way' or four-sided outlet, and should preferably be located above roof level to avoid the effects of eddies and down-draughts under certain conditions of wind direction. The extract fan for the disposal corridor and anaesthetic areas, etc., should be interlocked with the main supply fan, so that it cannot operate unless fresh air is being supplied to the theatre.

Ventilating plant

(a) Fresh air inlet

121. This should preferably be located about 10 ft above roof level and well away from possible sources of contamination such as chimneys or the exhaust outlet of ventilating systems. The inlet should never be placed inside the plant chamber. The design should provide protection from sun and rain and ensure a steady intake of air under varying conditions of wind speed and direction. A common intake may serve two or more ventilating plants, but each must have a separate filter chamber, carefully arranged so that both the pre-filter and main filters can be changed externally without the risk of contaminating the internal sections of the plant and ductwork.

(b) Filters

122. Filtration of incoming air down to 5 microns in size is bacteriologically adequate. When using the test dust No. 2, in accordance with the procedure laid down in the B.S. 2831: 57, the filter, or series of filters, in a clean condition should have a gravimetric efficiency of between 95 per cent and 99 per cent. The recommended arrangement is to have a coarse pre-filter to remove about 50 per cent of the particles down to 15 microns in size and that this should be followed by a main filter to remove particles down to 5 microns. Further cleaning is fortuitously provided where a spray washer is used. A moisture eliminator of the nylon pad type described later, which must be used with a spinning disc type humidifier, also provides this additional cleaning function.

123. Where the plant includes low temperature cooling coils which are likely to be wet for long periods it is likely that these will become contaminated with bacteria and the addition of a final (5 micron 95 per cent efficiency) filter near to the air delivery grilles would be desirable. In this case the main filter mentioned above need not be more than say 80 per cent efficient.

Pre-filters

124. Coarse pre-filters are usually of the throw-away type. A suitable type which needs relatively little maintenance operates on the same principle as the roll-film in a camera, the clean filtering media being unwound and exposed to the airflow before being wound on to the dirty spool for disposal. The operation of these filters may be motorised, but the plant should be visited daily, and manual adjustment of the travel of filtering media could be done at these visits. An alternative now available for which a life of about 10 years may be expected, is made up from pads of stocking-weave open knit nylon of 1 in. to 2 in. in thickness, which can be quickly and simply cleaned in a bath of detergent and then rinsed in a germicidal solution. As mentioned above, similar pads can also be used to form a moisture eliminator screen.

Main filter

125. The main filter may be either the boxed, lint type with a large exposed surface, or the roll type described above, but with a heavier filtering media to give the required efficiency. To prevent leakages of unfiltered air the roll filter must be fitted with satisfactory air seals at the side frames, and the boxed type must be carefully and positively sealed at the outlet side of the frame.

Electro-static precipitators, absolute filters and ultra-violet air sterilisers

126. Consideration of these would be justifiable only where the 'fresh' air was particularly smoky and dusty.

127. The inclusion of self-cleaning devices and safety precautions has improved the performance of electro-static precipitators, but it is still necessary to provide coarse filters upstream from these precipitators to prevent large particles or insects in the incoming air being lodged on the plates, and thus causing arcing between the elements. Objections have occasionally been made to the production of ozone by the precipitators. Recent improvements in design suggest that it may not be necessary to provide downstream filters for use in the event of failure of the electricity supply, but in this case reliability and cost considerations would probably be deciding factors. The value of ultra-violet air sterilisers is questionable as some organisms may be protected by dust and not be killed and may thus penetrate the system.

Final filters

128. In designs including wet cooling coils it may be desirable to provide a third-stage filter to ensure that there is no carry-over of particles 5 micron or larger in size.

129. To be most effective the filter should perhaps be placed in the terminal position, i.e. in the theatre, since here it would also prevent dust in the warm air from the theatre entering the air supply duct by thermal convection, etc., when the plant was not running. However, in this position it would offer a large uncleanable surface from which the dust collected on the face might be shaken free by pulsations in the air due to wind or the opening and closing of doors or blown into the theatre when the plant was started up.

130. If it were of the high efficiency terminal type the air would enter the room at very low velocity and the direction of flow would be difficult to control. The distribution would be very sensitive to the effects of temperature differentials in summer and winter, the cooler air introduced in summer would tend to fall quickly to the floor and in winter the warmer air would tend to stratify at high level.

131. It is preferable to accommodate a final filter in a position where it is easily accessible for maintenance and where the duct size may be sufficiently reduced to ensure that the velocity of air approaching the outlet grille or diffuser will give the desired directional airflow into the operation room.

132. A suitable position may be at the end of the air conditioning plant as the air duct leaves the plant room, but the final stage air heater for the theatre should be placed in front of the filter to ensure that the filter-media is not subject to dampness due to moisture carryover from the humidifiers.

133. Filters are normally serviced by the exchange at one time of one-third or one-half of the dirty units, but adequate spares must be carried to permit a full change of filters when necessary.

(*c*) *Airflow indication*

134. An air resistance indicator should be fitted across each bank of dry filters to show the pressure drop in water gauge. Also a flap-operated switch should be provided in the main duct to operate a warning light when the airflow has fallen below a predetermined volume. The light would illuminate an indicator situated in a position readily seen by the theatre staff. Electric indicating lamps for this purpose should be of the neon type.

(*d*) *Fan*

135. It is usual for fans of the slow speed centrifugal type to be used. They have low peripheral velocity at the tips of the blades and are driven by V-belt from a super silent motor.

136. Axial flow fans may be suggested where the design load and plant layout may favour this arrangement, but there are certain disadvantages in having the motor in the main airflow.

137. Conventionally, the fan is positioned with the filters, humidifier and heater on the suction side. There would, however, be a considerable reduction in the risk of admitting unfiltered air into the system if the fan were positioned immediately before or following the main filter.

138. Where the fan precedes a cooler or heater battery and/or a humidifier the discharge from it should pass across a well-designed diffuser and splitters to ensure even distribution of the air across the full area.

139. An air seal should be provided on the impeller shaft and a spare motor should be available for quick replacement in the event of motor failure.

(*e*) *Heater batteries*

140. It is extremely important that the heater batteries should not be of so great a capacity that difficulty of control is experienced during periods of low heat demand. The temperature rise and 'leaving' temperature of the air from pre-heaters and after-heaters should be carefully specified to take account of the efficiency of the humidifier. Normal design conditions would allow for an outside temperature of 30°F, the pre-heater giving a rise of not more than 60°F before humidification and the after-heater giving a rise of not more than 15°F to 20°F. In exposed areas which are subject to very low temperatures and icing conditions there are advantages in the seasonal use of a separate primary heater consisting of plain tubing placed between the fresh air inlet louvres and the primary filter, to give a temperature rise of about 15°F to keep the filters dry and prevent ice formation.

141. Steam-heated batteries are very difficult to control within close limits of temperature unless the control valve is carefully sized for the required duty. The steam supply pressure to the valve should not exceed 5 lb per square inch and the valve should absorb about half of this pressure during its operation. Valve seatings should be made of special alloy and designed to minimise wire drawing of the steam which often causes scoring of the valve seats. For these reasons the use of steam-heated batteries is not generally recommended; better temperature control is achieved by the use of low pressure hot water with a thermostatically controlled mixing valve in the circuit. In all cases a dial thermometer with a suitable scale range (50–100°F) should be fitted in the airflow duct as it leaves the plant room, so that a check can be made that the controls are functioning satisfactorily.

(*f*) *Humidifiers*

142. To maintain a relative humidity of not less than 50 per cent in the operating theatre it is necessary, over the greater part of the year, to add moisture to the air. The amount required varies over a very wide

range but it is most important not to add too much. The maximum requirement arises during frosty weather: when the outside temperature rises to about 65°F it will seldom be necessary to add any moisture. The humidifiers used for this purpose should be designed for either a two-step or a modulated control, so as to give efficient operation between maximum and zero conditions. Notes on certain types of humidifiers are given below.

143. Plastic corrosion resistant finishes are available for the internal surfaces of humidifier chambers and should be used where the water in the humidifier is chemically treated. Drain and overflow piping must be fitted with an efficient permanent water seal trap and arrangements made to ensure that it cannot become dried out. It is extremely important to prevent ingress of air to the system through these pipes or through any test holes, door gaskets, joints, etc., downstream to the filter. Adequate access for satisfactory maintenance is essential for all types of humidifiers.

(i) *Spinning disc type*

144. This type is preferred. It has the great advantage that clean, fresh water is used exclusively, either direct from the mains or after softening. Good control of humidity is obtained by installing more than one unit and by the modulated control of water supply: in winter all units would be used, in summer summer perhaps one unit only. Precautions must be taken to minimise noise and vibration, and thermal overload releases operated by higher temperature in the motor windings are usually provided. A moisture eliminator of the stocking-weave nylon type is usually installed to prevent moisture mist being carried into the supply ducting.

(ii) *Air washer*

145. These units occupy a larger amount of space than other types, tend to be noisy and have a relatively high pumping cost. Good control of humidity conditions is obtained by the use of one or both of two banks of sprays according to the outside air condition. The water used is re-circulated through a tank and therefore tends to collect impurities and become acid unless frequently changed. This may be done by having a continuous dribble at the overflow. The use of chemicals to disinfect the water has disadvantages. The sprays tend to become blocked very easily, so that regular inspection and servicing is required.

(iii) *Capillary type humidifier*

146. The small interstices between the fibres of this type give it high humidifying efficiency, but the high moisture content of the pads tends to render humidity control sluggish. The pads may become clogged, particularly in hard water districts, unless they are cleaned at regular intervals. The water in the tank is re-circulated and should be changed frequently, as above.

(iv) *Steam humidification*

147. The use of steam direct from the main service must be carefully controlled if over-heating is to be avoided. It often gives rise to a noticeable smell in the air supply. The use of a steam-heated water trough in the airflow is not recommended because of difficulties of control and noise. Local steam generators give better control and may be almost odourless, though if electrically operated they tend to be costly in initial expense and servicing, especially in hard water districts.

(*g*) *Noise*

148. The ventilating system should be designed for silent operation; the desirable noise level in the theatre may be taken from Noise Criteria Curves N.C. 30. Elsewhere in the department the noise level may be N.C. 35, with a high limit of N.C. 40.

149. Fans and pumps should be carefully mounted and insulated so that vibrations are not transmitted to the structure, or distribution ductwork.

150. For low velocity schemes without sound attenuation air velocities in ducts should not exceed 1,000 ft per minute in the main duct and 600–800 ft per minute in branch ducts. The air discharge velocity and volume from grilles or diffusers should be adjustable and free from noise. Lining of ducts with sound absorbing material is not desirable owing to the risk of mechanical damage and the subsequent dispersal of the insulating media into the ventilating system.

(*h*) *Automatic control*

151. The basic environmental conditions required in theatres fall within a range of 65°F to 70°F, with a temperature differential of ±2°F, and relative humidity of 55 per cent ±5 per cent. These conditions are obtainable with a relatively simple control system which requires little attention or adjustment to give consistently good service. Thermostats and humidistats should be carefully sited inside the theatre at a height of approximately 5 ft with an air space behind to ensure correct response, and to give close control of conditions required near to the table. Control equipment should indicate settings clearly and accurately with key operation so that they can be altered only by authorised persons. Pneumatic controls have the advantage of reliability and simple maintenance.

Refrigeration and air conditioning

152. If the operating department is carefully designed to eliminate heat gains wherever possible it is likely that the use of refrigeration will not be necessary in districts of Great Britain where cool summers are commonplace, though in the southern half of England particularly there could be a case for cooling plant to reduce theatre temperature in summer.

153. This case for cooling plant may also apply in theatres where certain specialised forms of surgery, and lengthy operations at which exceptionally large numbers of staff are present, are to be carried out, or where site or other factors impose a design solution for the hospital building which makes air conditioning of the theatres unavoidable.

154. The use of dry cooling coils instead of cold water sprays in an air washer provides an efficient method of cooling which should be considered as an alternative to the conventional system of cooling and re-heating. Satisfactory trials of a dry cooling coil system have been made and are described in Appendix II, which also gives advice on the construction of coils for easy cleaning. Provided the system is designed with the cooling water temperature not lower than 50°F to 54°F the coils will remain free from moisture due to condensation and the attendant risk of bacterial growth. Such a system would provide mainly sensible cooling only and lack full control of humidity but it would need a much smaller

refrigerating plant, so that both capital and running costs would be markedly lower.

155. Occasionally the cooling coils may be used in a wet condition, and it is advisable to provide access to enable them to be cleaned weekly. This also applies to the conventional wet cooling coil system and in the case of this the additional precaution of a final filter after the plant is probably justifiable.

Testing, commissioning and maintenance

156. Arrangements for the proper testing and commissioning of the ventilating plant before acceptance are essential. The internal cleansing of the ventilating plant, the correct functioning of all controls, demonstration of satisfactory air distribution by smoke test, etc., and balancing of air volume supplied to the department must be carefully supervised and all necessary adjustments made during the first six months and under extreme summer and winter conditions by the installing engineer. Emergency routines should also be demonstrated to be satisfactory under all conditions during these periods.

157. The resident engineer should be supplied with operational manuals and charts, drawings, diagrams, etc., giving full and proper details for maintenance and testing of all parts of the installation as maybe required from time to time. The engineer and the theatre staff should also receive instruction wherever applicable to ensure that the plant is operated in the most efficient manner.

158. Spare motors, filters, components for the control systems together with a spare unit, e.g. spinning disc humidifier, should be available for quick exchange when required.

159. The design must make provision for satisfactory maintenance with good access for cleaning, particular attention being given to cleaning holes in air ducts, humidifier chambers, filters, heating or cooling batteries, and drainage points should be carefully sealed against air ingress into the system. Further information on these aspects is given in the M.R.C. report referred to in paragraph 98.

Heating and ventilation

160. The ancillary rooms in the department will normally need to be mechanically ventilated to avoid upsetting the desirable pattern of air movement in the main rooms. An average of six air changes per hour should be aimed at, with 70°F in the endoscopy and plaster rooms (where, exceptionally, these are provided) and 65°F elsewhere. In the somewhat unlikely case where these rooms can be naturally ventilated, the space heating system should be designed for two air changes per hour.

161. Mechanically ventilated rooms in exposed positions may require background heating to minimise condensation and to enable the main rooms to be made ready at short notice. The heating arrangements for these rooms should be designed to give a temperature of 60°F allowing for no air changes. It may be desirable to shut off the heating system circulation when the ventilating plant is in use, and this may be done by providing an electrical cut-out to the heating system pump which will operate when the ventilating plant is started, or with independent control by an over-riding switch having appropriate indicating lights at the control position in the department.

162. No background heating is needed to internal theatres having no external walls since the air volume recommended in this Note (1,000/1,200 cu ft per minute) will ensure that satisfactory conditions will exist well within 15 minutes of switching on the ventilating plant.

163. If ceiling heating systems are used they should conform to the recommendations of the Medical Research Council's Environmental Research Unit which may be found in the *Guide to Current Practice* of the Institution of Heating and Ventilating Engineers.

164. A disadvantage of embedded heating panels is that the surrounding structure retains heat for a considerable time after circulation to the panels has been stopped, with consequent overheating of the room should the outside temperature rise suddenly. It is important not to install too much heating surface, particularly in ventilated rooms. Panels should be on the perimeter of rooms and arranged to counteract radiated heat loss from external walls and windows.

165. Flat wall surface heating panels are sometimes used in the theatre, and should be at a high level so that convection currents are less likely to circulate dust and interfere with the movement of air over the operating table. However, it is difficult to seal the joint between panel and wall surface without a crack developing.

Hot water, cold water and drinking water services

166. These will normally be provided from the main services of the hospital. Where local storage calorifiers are used it will be necessary to duplicate them (and the associated pumps, etc.) so that repairs and maintenance can be carried out without interruption of supply. Their size will depend on the needs of the sinks, basins and showers and should be based on a two-hour recovery period. The consumption of water per theatre for washing down and wash-up purposes is reduced where a group of theatres has central wash-up facilities. Elbow-operated taps with a mixed temperature outlet will be required except for the low-level sinks, where normal pillar taps of the easy-clean, chromium-plated pattern should be provided. Showers should have hot and cold water mixing valves and be served where possible from a common head tank to give balanced pressures, and the spray should be adjustable at shoulder height. Drinking water taps should be taken directly from supply authority mains. Hot water plant and circulating pipe-work (including drinking water piping running near steam or hot water pipes) must be adequately insulated. Useful guidance on water storage and consumption is given in the Hospital Engineering Research Unit's report of September 1964.

Piped suction, oxygen and medical gases

167. It is usual to provide piped suction, oxygen and nitrous oxide outlets in anaesthetic and operating rooms and suction and oxygen outlets in the post-operative recovery rooms. The outlets can be wall-mounted or be on booms from the walls or be suspended from the ceilings. Booms need regular cleaning to avoid dust collection.

(*a*) *Suction*

168. It is usual to provide two suction outlets in the operating room, one for use by the surgeon and the other for use by the anaesthetist; one outlet in the anaesthetic room; and one per bed in the recovery room. However, tee outlets can be provided where necessary. The degree of vacuum required for medical suction should be adjustable by means of a needle valve to the desired amount but it does not usually

exceed 20 in mercury column. An electrically operated vacuum pump with a reservoir tank to stabilise the degree of vacuum in the system is normally installed in or near to the plant room or gas cylinder room. For the larger systems there are advantages in having two pumps actuated by suitable pressure switches whereby the capacity of one pump will deal with normal requirements and the duplicate pump will cut in to operate in the event of heavy demand. A suitable change-over switch will facilitate servicing and maintenance. The pump unit should be silenced and insulated against sound, but provided with good access for cleaning; and the discharge (which may contain anaesthetic gases and bacteria) should be taken outside the building clear of opening windows and air intakes. It is usual to provide an additional portable electrically operated self-contained suction unit which can be plugged in at any convenient position; these units should comply with the requirements of the Safety Code, referred to in Hospital Technical Memorandum No. 8.

(*b*) *Oxygen supply*

169. The department will normally be supplied from the main hospital's oxygen distribution system, the source of the supply being either a liquid oxygen plant or a battery of large cylinders. The oxygen gas is usually led from the control panel to the department through copper piping: plastic piping may not be suitable for this service. A warning light to indicate drop in pressure of supply should be provided in the theatre superintendent's office to supplement the warning arrangements provided elsewhere for the main system.

(*c*) *Nitrous oxide*

170. Nitrous oxide outlets may be provided in the operating and anaesthetic rooms as an alternative to the use of cylinders on the anaesthetist's trolley. Cylinders feeding a piped supply should be connected to manifolds with control panels and with similar safety provisions as in the case of oxygen.

(*d*) *Compressed air*

171. The demand for compressed air in the operating departments rarely justifies a piped supply and can usually be met from an air cylinder brought in when necessary, care being taken of the need for cleanliness. A piped compressed air supply, may, however, be required for the operation of pneumatic controls for the ventilating plant and this could be extended to points in the theatres where air operated surgical tools and dental equipment are frequently used, although the air pressure required varies from 15 p.s.i. for control purposes to as high as 160 p.s.i. for certain equipment. Compressed air may not be sterile and exhaust air discharged from controls and equipment should be piped away from areas where practicable. Compressors are noisy and cause vibration and the possibility of this causing a nuisance in the theatres should be guarded against. Where air from compressor supply is used for breathing an oil removing filter should be installed.

Sterilising equipment

General

172. Theatre linen, dressings, gloves, needles, syringes and certain items of anaesthetic equipment are normally dealt with in the central sterile supply department. Operating theatre instruments and bowls will normally be processed in a T.S.S.U. in the absence of a conveniently placed C.S.S.D. There should be no sterilising in the theatre suites.

173. Steam sterilisers normally require a working pressure of 32 p.s.i. (276°F or 136°C) within the chamber, and to ensure this at all times local steam services must be sufficient to give a pressure above 50 p.s.i. Steam must be as dry as practicable, not less than ·95 dryness fraction, but not superheated and as free of air as possible (see Hospital Technical Memorandum No. 10, Appendix V).

174. Sterilisers should be provided with inter-space shelving designed to deflect condensate from dripping on to the packages or tray below and having sufficient metal content to ensure heat retention for the effective drying out of fabric in the packages or tray on completion of the sterilising cycle. Pressure steam sterilisers, having an automatically controlled cycle incorporating pre-vacuum stages, are necessary for use with wrapped instruments and pre-set trays. Rectangular chambers are preferred by operators and careful attention to the arrangement of loads and to a high utilisation of chamber volume are necessary to promote the highest level of sterilising efficiency. The total time of the sterilising cycle is from 20 to 30 minutes. Machine cycles vary between makes, but consist of a pre-vacuum (which may or may not be in the high vacuum range), drawn in one or more stages, with steam pulsing between, or continuous steam injection during these stages; followed by a sterilising stage admitting steam at 32 p.s.i.g. for a holding period; and a post-vacuum stage finally for load drying.

175. The use of a hot air oven for delicate theatre instruments may occasionally be required. This may be provided in the C.S.S.D. if it is at the hospital or alternatively in the T.S.S.U. No stand-by oven can be justified and other arrangements should be made when the regular oven is out of use. Sterilisation in a hot air oven requires that the instruments shall be maintained at a temperature not lower than 160°C (320°F) for at least one hour.

Number and size of sterilisers

176. The following recommendations assume that sterilising work arising from all theatres in the hospital will be concentrated in the C.S.S.D. and the main T.S.S.U., i.e. detached theatres (e.g. in the accident and emergency department) need not be provided with sterilising facilities (see paragraph 8). The consequences of this principle is that it will be necessary to wrap the bowls and instruments and to use high vacuum sterilisers. The bowls used should be kept to minimum sizes consistent with requirements so as to reduce the loading of the sterilisers. Machines can be more efficiently used, with consequent savings in capital, maintenance and running costs, and in space, if the practice of processing a number of operation sets together is adopted. The British Standard sizes of sterilisers presently available are given in Appendix VIII (C) of Hospital Technical Memorandum No. 10, but for convenience the preferred sizes for T.S.S.U. are repeated in the table below.

Minimum height	*Minimum width*	*Minimum length*	*Nominal cubic capacity*
26 in	26 in	26 in	10 cu ft
36 in	26 in	26 in	14 cu ft
36 in	26 in	39 in	21 cu ft

Smaller capacities in the rectangular form are also on the market but it is unlikely that their use in the T.S.S.U. would be an economic proposition.

177. High vacuum sterilisers should conform to the revised British Standard specification for sterilisers (steam) for porous loads, which is now in draft, and which will supersede B.S. 3219 and 3220. Hospital Technical Memorandum No. 10 should also be consulted on the design, installation and maintenance of pressure steam sterilisers.

178. Because the turnover of instruments and bowls varies very widely according to the types of operation carried out in the department and the effectiveness of the machines, it is not possible to give more than a conservative indication (see the table below) of the output from individual machines. In assessing the size of the installation, however, it is important to bear in mind that over-provision may lead to the machines being frequently run with substantially less than a full load, a condition which is likely to reduce their sterilising efficiency. It is reasonable to assume that a steriliser can be used for at least twelve process cycles per day, allowing for preparation, loading and off-loading. It is also necessary to have stand-by arrangements to provide for servicing, as mechanical troubles occur from time to time. The provision of sterilisers on the scale indicated in the table below should meet all normal and foreseeable requirements, on the assumption that a C.S.S.D. is available for the sterilisation of normal theatre linen.

No. of theatres	*No. and size of sterilisers*	*Installed capacity cu ft (nominal)*	*Notes*
Two up to six	Two 26 in × 26 in × 26 in	Two at 10 cu ft each	High vacuum type each coping with up to 24 No. 24 in × 24 in trays per day, or 48 No. 11½ in × 11½ in × 10 in boxes per day, or 100/500 packages of various size and content per day.
More than six	Two 36 in × 26 in × 26 in	Two at 14 cu ft each	*Each* coping with: 36 No. 24 in × 24 in trays per day, or 72 No. 11½ in × 11½ in × 10½ in boxes per day, or, 150/720 packages of various size and content per day, e.g. bowls of various sizes.

Note.—The provision of two sterilisers satisfies the need for stand-by arrangements, the aim should be to have equally sized machines, each capable of dealing with the daily load.

Sterile water

179. Sterile water for operating theatre requirements is best provided in bottles. A hot cupboard is required for bottled hot water. It is essential that electrically heated cupboards should be fitted with pre-set non-self re-setting safety thermal cutout to prevent overheating, in addition to the controlled thermostat. In a soft water district the bottles can be filled from the mains, but where the mains supply is hard, distilled water should be used. Sterilising will normally be done in a pressure steam steriliser in the C.S.S.D. or pharmacy.

Electrical installation

General

180. The electrical installation should comply with the Regulations for the Electrical Equipment of Buildings, issued by the Institution of Electrical Engineers. In rooms where flammable anaesthetics are likely to be administered the special safety recommendations of the Report of a Working Party on Anaesthetic Explosions (Ministry of Health) should be complied with.

181. The installation should include wiring and equipment for general and special lighting, emergency supplies, socket outlets, heating, ventilating, telephones, clocks and call systems. There may be a requirement for patient monitoring and other special electro-medical apparatus.

Electric wiring

182. Electric wiring should be permanently installed as far as is practicable and have good fire-resisting properties, e.g. p.v.c. insulated cables enclosed in steel conduit, or mineral insulated metal sheathed cables. Where possible, wiring in the principal rooms should be in service ducts or buried in the structure. Where it is essential to use flexible wiring connections they should have an earthed metallic screen in addition to the usual earthing conductor, and an outer protective sheathing of insulating material.

Supply and distribution

183. Guidance on electricity supply and distribution is given in Hospital Technical Memorandum No. 7, Electrical Services; Supply and Distribution. The electrical supply will usually be provided by a sub-main circuit from the main intake and distribution centre to a switch-room in a convenient position in the department. Local distribution boards should be sited to minimise the length of circuit wiring. They should be in well ventilated positions preferably accessible from corridors without the need to enter clean or sterile areas, and it is an advantage if they can be reached from a standing position. H.R.C. fuses are recommended for general use. Miniature circuit breakers if used should comply with B.S. 3871, Part 1. Adequate spare capacity should be allowed for possible future extensions and space allowed to enable additional units to be added.

General lighting

184. Until recently tungsten filament lighting has been used in theatres and anaesthetic rooms because its spectral distribution (having a prominent red output) has been preferable to that of fluorescent lighting for medical colour identification purposes. Also staffs were more familiar with its colour rendering properties. However, recent tests have shown that certain fluorescent lamps have acceptable colour rendering properties and with the use of these it is now possible to take advantage of the higher efficiency, lower heating effect and better light distribution of fluorescent lighting.

185. It is important that the same type of lamps for general lighting is used in all areas within the department.

The colour of the walls and ceilings can have a significant influence on the colour of lighting, particularly where concealed or lay lighting is used and therefore decoration colours need to be carefully chosen in areas where colour identification is important.

186. All lamps installed in theatres and anaesthetic rooms should be enclosed to a degree which permits the fragments to be contained in the fitting if a lamp breaks. Low level lighting fittings should be cnclosed sufficiently to protect them against mechanical damage and water splashes, and in all the main rooms, enclosed fittings installed at ceiling level with no exposed upper surfaces will eliminate the possibility of dust collection. Fittings should have sufficient surface area to avoid excessive glare, and should be capable of easy cleaning.

187. The following are recommended values for general illumination:

Accommodation	*Average lumens/sq ft recommended at working level*
(*a*) Operating theatre (background lighting)	30
(*b*) Laboratory (where provided)	25
(*c*) Anaesthetic room Scrub-up Recovery area Sterilising and packing areas of the T.S.S.U. Theatre preparation room	20
(*d*) Offices Staff changing and rest rooms Cleaning area of the T.S.S.U. Transfer/reception area Porters' station Ancillary rooms serving recovery area Corridors Tea pantry Disposal corridor	15
(*e*) Lavatories Store Trolley bays Staircases Cleaners' room	7 (at floor level)
(*f*) Darkroom (white lighting)	5

Special lighting

Operating table lighting

188. The operating table lamp should be capable of being directed at any angle, have good shadowless properties, be reasonably cool and be capable of lighting deep cavities.

189. Tungsten lighting is invariably used, and since efficiency is approximately inversely proportional to the operating voltage it is recommended that 24-volt lamps are used. At least two separate light sources should be used so that sufficient lighting will be available should one source fail.

190. It has been suggested that an intensity of 1,000 lumens/sq ft on the working plane should be adequate and that intensities above this will achieve relatively small improvement in visual acuity but will increase eye strain. In practice, however, many surgeons prefer higher intensities and values between 2000 and 5000 lumens/sq ft are frequently used.

191. With this degree of intensity an efficient heat filter is necessary and switching and/or dimming will usually be required to enable the intensity to be varied.

192. Housings of lighting fittings should be totally enclosed and where switches or dimmers are incorporated, they should be reasonably gas-tight and have sufficient surface area to dissipate the heat produced without undue temperature rise. They should have smooth surfaces and be easy to clean.

193. The suspensions of the lighting fittings should be sufficiently flexible to enable the light to be directed at any position within the operational area.

194. In theatres which are used for operations involving the simultaneous exposure of two operating fields, a lighting fitting having two separate lamp housings which can be independently manoeuvred can be used, or, as is more usual, an additional portable fitting can be used to supplement the main lamp. Portable fittings should be generally in accordance with B.S. 3541.

Anaesthetic room

195. The general lighting should be by ceiling mounted fittings arranged to avoid the patient on a trolley from experiencing glare when looking upwards. The colour should be the same as the theatre general lighting. A wall or ceiling mounted adjustable spotlight may be required for treatment purposes. Alternatively a portable examination lamp complying with B.S. 3541 should be provided.

Drug cupboards

196. Drug cupboards in the recovery room should be provided with red indicating lights to give visual indication when the cupboard is not locked, in accordance with B.S. 2881. Those in the flammable anaesthetic risk area should be located at least 4 ft 6 in above floor level to comply with the safety recommendations.

X-ray film viewing screens

197. For x-ray film viewing screens fluorescent light is usually to be preferred. Cold cathode fluorescent lighting is more expensive than the ordinary type but has the advantage of permitting better light distribution and variation of intensity. The screens should be recessed so that the front of the frame is flush with the wall surface and have sufficient illumination for four films. Switches, transformers, chokes and capacitors should be housed in an incombustible total enclosure and mounted at least 4 ft 6 in above floor level. Special attention should be given to high voltage terminations on cold cathode fluorescent fittings to ensure adequate insulation and spacing and so minimise the possibility of flash-over or tracking.

Switches and sockets

198. Switches and socket outlets installed in anaesthetising areas should comply with the 'Report of a Working Party on Anaesthetic Explosions'. Mains type socket outlets which are intended to supply equipment having an energy rating of less than 3 kW should be of the 13 amp type inter-locked with a gas-tight (e.g. mercury) switch.

199. The number of socket outlets should be sufficient to allow each portable appliance which is likely to be used at the same time to be separately connected to a conveniently located socket. The following distribution of socket outlets is suggested:

(*a*) Operating theatre	Four to six twin outlets plus provision for fixed electrical apparatus and two mobile x-ray machines
(*b*) Anaesthetic room	Three twin outlets
(*c*) Recovery area	One twin outlet for x-ray viewing screen; two twin outlets for each bed position
(*d*) Reception area	One twin outlet for each bed position
(*e*) Plaster room (where provided)	One twin outlet for equipment; one outlet for general purposes
(*f*) T.S.S.U. (clean area)	Two twin outlets
(*g*) T.S.S.U. (cleaning area) Theatre preparation room Changing rooms Offices Tea pantry Workshop (when provided)	One twin outlet
(*h*) Darkroom	One twin outlet plus one single outlet (according to room size)
(*i*) Laboratory (where provided)	One twin outlet per 2 ft run of bench top
(*j*) Utility rooms, cleaners' room, corridors	General purpose outlets for domestic appliances, etc.

X-ray sockets

200. It is important that the same type of socket is used throughout the hospital for x-ray purposes to avoid the use of adaptors. Any special x-ray socket outlets installed in the operating theatres should thus be similar to those provided elsewhere in the hospital for this purpose.

201. It is a feature of x-ray apparatus that a heavy current is used for a very short duration (usually less than one second). Because of the transient nature of the load there is no risk of overheating such as may occur with more continuous heavy loads, so that 13 amp sockets are suitable from the current carrying aspect. 13 amp plugs of normal design may not be appropriate for larger x-ray machines (e.g. those of 300 and 400 mA ratings) because of the need to accommodate large conductors which are necessary to avoid excessive voltage drop. A special 13 amp plug and socket having larger terminal facilities is being developed. Meantime use 30 amp sockets where the conductors cannot be accommodated in ordinary 13 amp plugs and sockets.

202. Ring circuits are particularly suitable for x-ray circuits because the two conductor connection to sockets assists in reducing voltage drop. Where only one heavy duty x-ray set is available there is no need to restrict the number of sockets on a circuit and circuits should be designed to make the most economical use of the conductors, bearing in mind the importance of limiting the voltage drop.

Extra low voltage outlets

203. In making provision for extra low voltage supplies for endoscopes and surgeons' headlamps precautions should be taken to minimise risks when this apparatus is used in the presence of flammable anaesthetics and when endoscopes come into direct contact with tissue or internal organs. Guidance on recommended voltages, intrinsically safe circuits and other appropriate precautions is included in the Working Party Report. Guidance on electro-medical apparatus, including safety requirements for transformers is given in Hospital Technical Memorandum No. 8.

Position of socket outlets in operating theatre

(*a*) *Wall mounted*

204. Wall mountings are most frequently used. The outlets should be distributed around the theatre walls rather than concentrated in one position. In particular sockets should be located so as to avoid trailing flexes which may hinder the movement of trolleys between the operating table and the anaesthetic room and the main exit from the theatre. The

best fixing height is probably 1 ft 6 in above floor level to avoid high trailing flexes and the possibility of water damage near floor level.

(*b*) *Suspended from ceiling*

205. Rigidly mounted overhead units situated near the operating table have the advantage of eliminating long trailing flexible cables across the floor but there may be difficulty in locating the unit to avoid restricting the movement of the operating table lighting fitting. An alternative arrangement is to use ceiling mounted sockets suspended on flexible cables. Rubber-clad cable-coupling types are particularly suitable for this purpose: 13 amp for mains, and 5 amp two-pin sockets for extra low voltage supplies for surgeon's headlamps.

(*c*) *Pedestal mounted*

206. A fixed pedestal for mounting socket outlets, etc., tends to restrict the working arrangements and occupy important space in the working area; for this reason they are seldom used.

(*d*) *Outlets incorporated in suspended lighting fittings*

207. This method is not recommended because of the possibility of the light being disturbed by accidental pulling of trailing flexes.

(*e*) *Floor mounting (flush with floor surface)*

208. This method is not recommended because of the difficulty of preventing damage due to the ingress of water, dust, etc.

(*f*) *Outlets mounted on mobile unit*

209. When sockets are mounted on a portable unit there are difficulties in complying with the safety recommendations. For example, the usual type of socket outlet having a mercury switch is unsuitable, because of the possibility of the unit being tilted.

Emergency electrical services

210. These should be provided in accordance with the guidance given in Hospital Technical Memorandum No. 11: Emergency Electrical Services.

Telephones

211. Telephone facilities for internal and external calls should be integrated with the hospital telephone system and provided, normally, in the superintendent's office(s), the clean corridor and/or the medical staff changing room. In offices, desk-type instruments may be installed but wall pattern instruments with adjacent shelf are more suitable elsewhere. Bell noise should be subdued and an indicating light which is easily visible may be installed outside the sister's office.

Inter-communication system

212. Inter-communication facilities are required between the operating rooms, laboratory and/or the pathologist in the main laboratory, and monitoring room; they will also be required to link up the theatre superintendent's office, theatre preparation rooms, T.S.S.U., recovery room and reception area. The system chosen should permit two-way conversation. A normal duplex, push-button station selection, inter-communication system will be suitable. Visual call signals only will be needed in the 'quiet' areas, but these may require to be supplemented by an audible call signal in other areas. Positioning of these units will, however, require careful consideration so that there will be no noise nuisance. In the cleaner areas it may be necessary to shroud instruments with suitably sealed polythene covers, or similar means, as a precaution against risk of cross-infection and to protect the instrument during wash-down periods. An additional duplex inter-communication system, switchless in the theatres, may be required where there is a monitoring room for direct communication between this room and the theatres.

Electric clocks

213. Electric clocks will normally be required in each theatre at the reception/transfer area, and to serve each corridor. A clock will also be required in the recovery area, anaesthetic room and T.S.S.U. Clocks in operating theatres may be synchronous, with a second (sweep) pointer, or where an impulse system is installed in the hospital they may be muted slaves with sweep second pointer, and provided with a time elapsed setting from datum.

Staff location system

214. The general staff location system of the hospital may be required for senior staff in the operating theatre department. With a bleep system an arrangement may be made by the senior staff to deposit their call units with a secretary, who will notify the telephone exchange.

Electrical interference suppression

215. With the increasing use of sensitive electronic equipment in operating theatres, the need for interference suppression should be carefully considered. Hospital Technical Memorandum No. 14: Abatement of Electrical Interference is relevant. Some of the advice this contains is as follows:

(i) All permanent mains wiring should be metal clad.

(ii) All flexible mains wiring within the room must incorporate a metallic screen which should be bonded to earth.

(iii) Any fluorescent lamps installed within 10 ft of the main working area where electronic apparatus may be used, should incorporate a fine wire mesh which should be bonded to earth.

(iv) Tungsten filament lamps, installed within 6 ft of the main working area, should be screened as above.

(v) All metalwork associated with mains type electric clocks installed in the room, should be bonded to earth.

(vi) Any transformers installed within 10 ft should be completely enclosed in an earthed metal (ferrous) housing.

(vii) Short-wave diathermy equipment should be spaced not nearer than 100 ft on three floors vertically, and the depth of modulation of the diathermy output should not exceed 30 per cent.

(viii) Surgical diathermy equipment should be equipped wherever possible with appropriate interference suppression. It is not practicable, however, to use sensitive electronic equipment in the same room while surgical diathermy is actually in use, but the provision of suppressors will reduce the interference caused in neighbouring areas.

(ix) Staff location systems using an inductive loop round the building and operating on low frequency, are liable to cause interference.

Sensitive apparatus should be spaced at least 30 ft outside any cable loops of this type.

Fire alarms and fire-fighting equipment

216. Information on fire alarms and extinguishers is given in B.S. Codes of Practice, in the Ministry's Circular on Hospital Fire Precautions, H.M.(56)36 and in Hospital Technical Memorandum No. 16 on Fire Precautions. Advice on the fire-fighting installation proposed should be sought from the local fire authority but consideration must be given to positioning and facilities for keeping it in a clean condition. Audible alarms should not be placed in any of the main rooms of the suite.

Figures 1

Diagrams showing flow of patients, operating team staff and supplies through the operating department

'A' and 'B' show alternative positions of transfer area

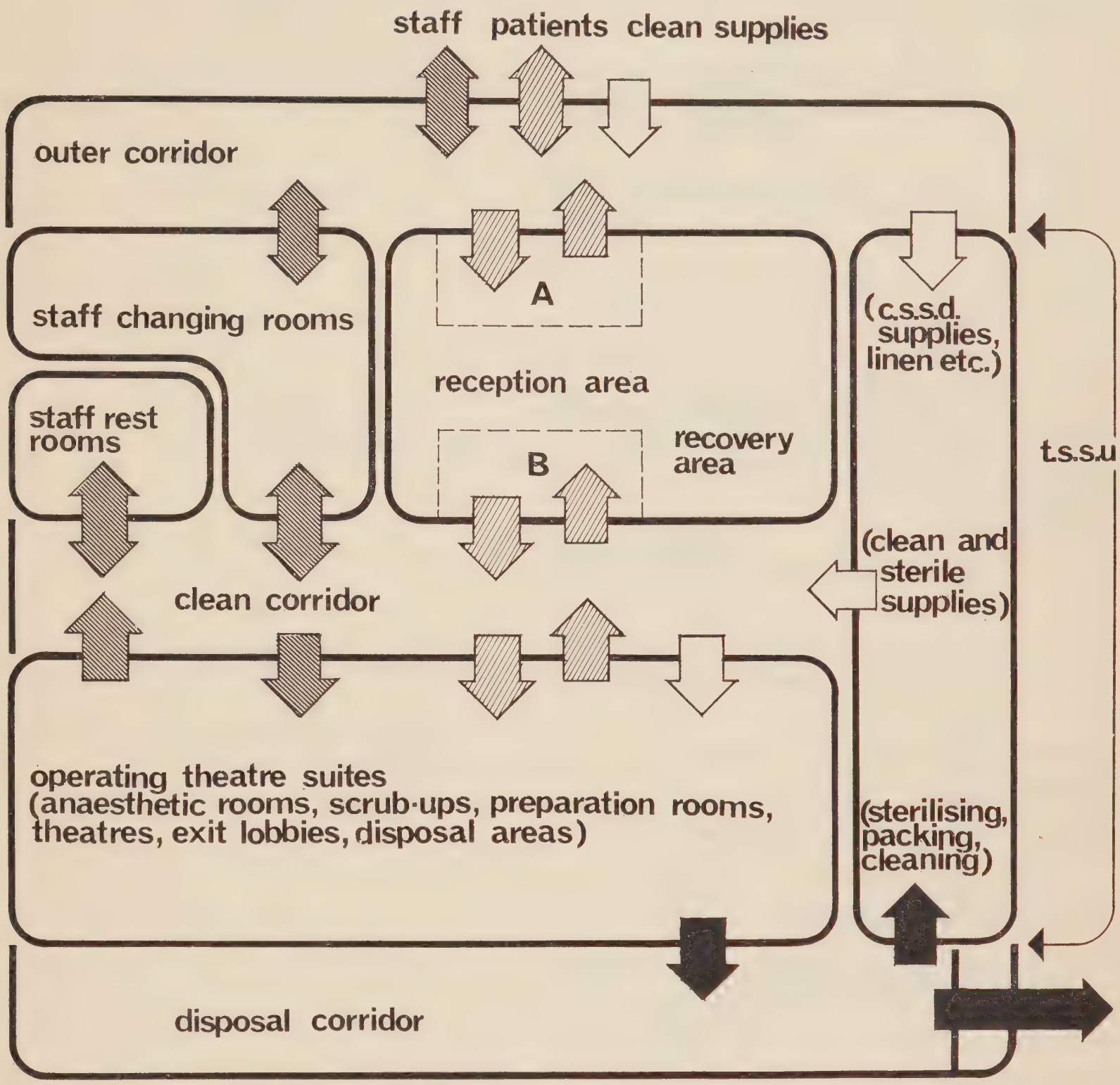


Figure 1(a)

KEY

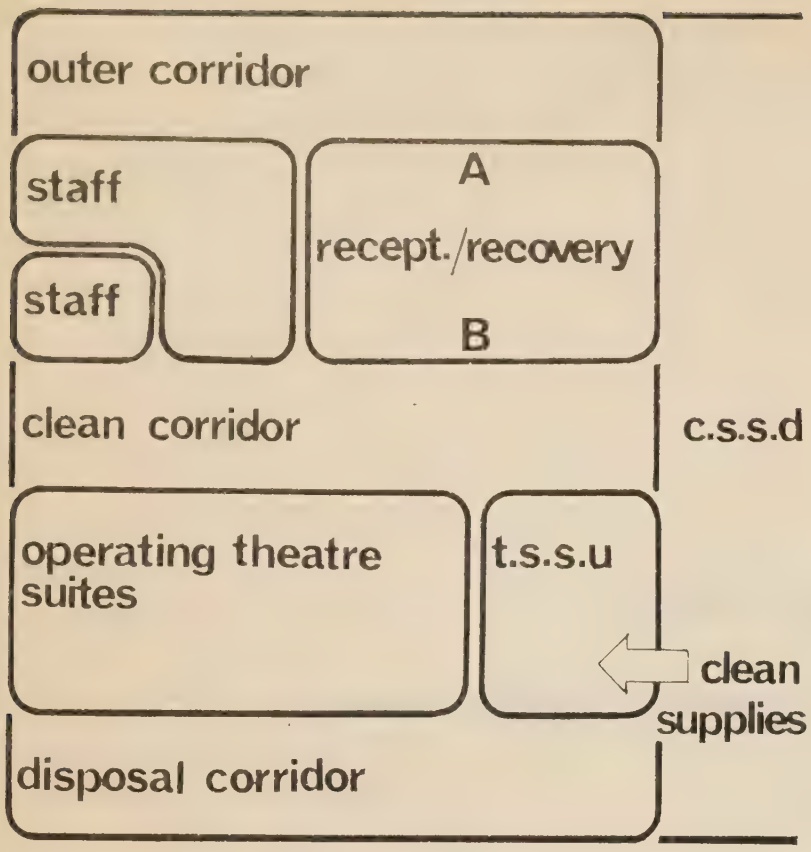


Figure 1(b)

Where the hospital C.S.S.D. is planned adjacent to the operating department, either below or alongside, it may be convenient for clean supplies to enter the T.S.S.U. directly, instead of via the main entrance.

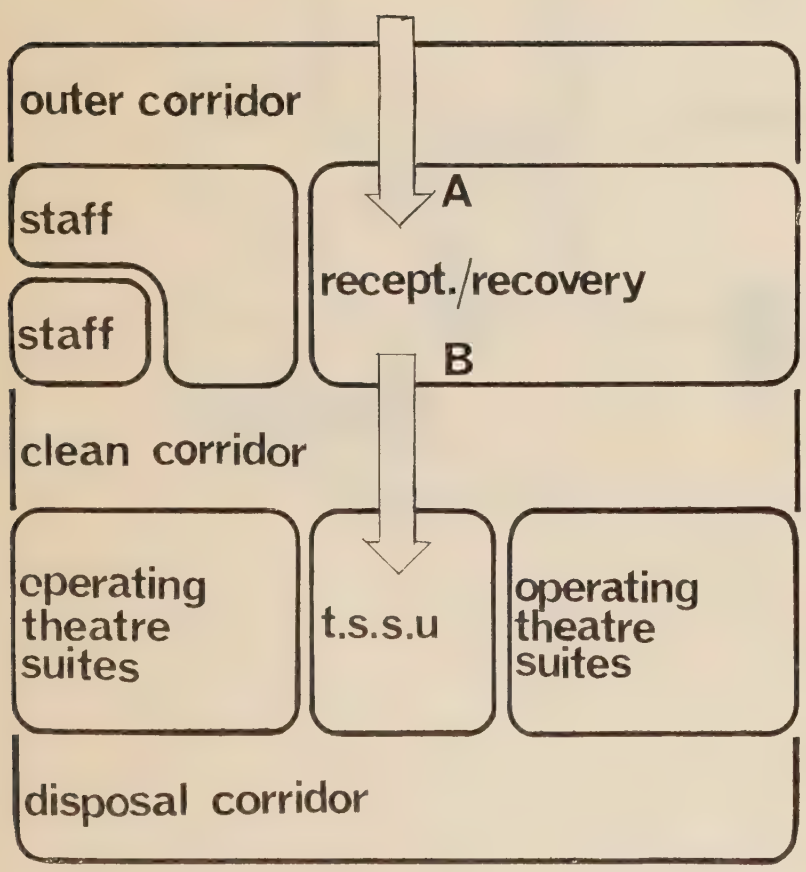


Figure 1(c)

In some cases it may not be possible to plan the T.S.S.U. as shown in Figure 1(a) or with the alternative direct entry as shown in Figure 1(b). It will then be necessary for the clean supplies to enter via the transfer zone and pass through the clean corridor to reach the T.S.S.U.

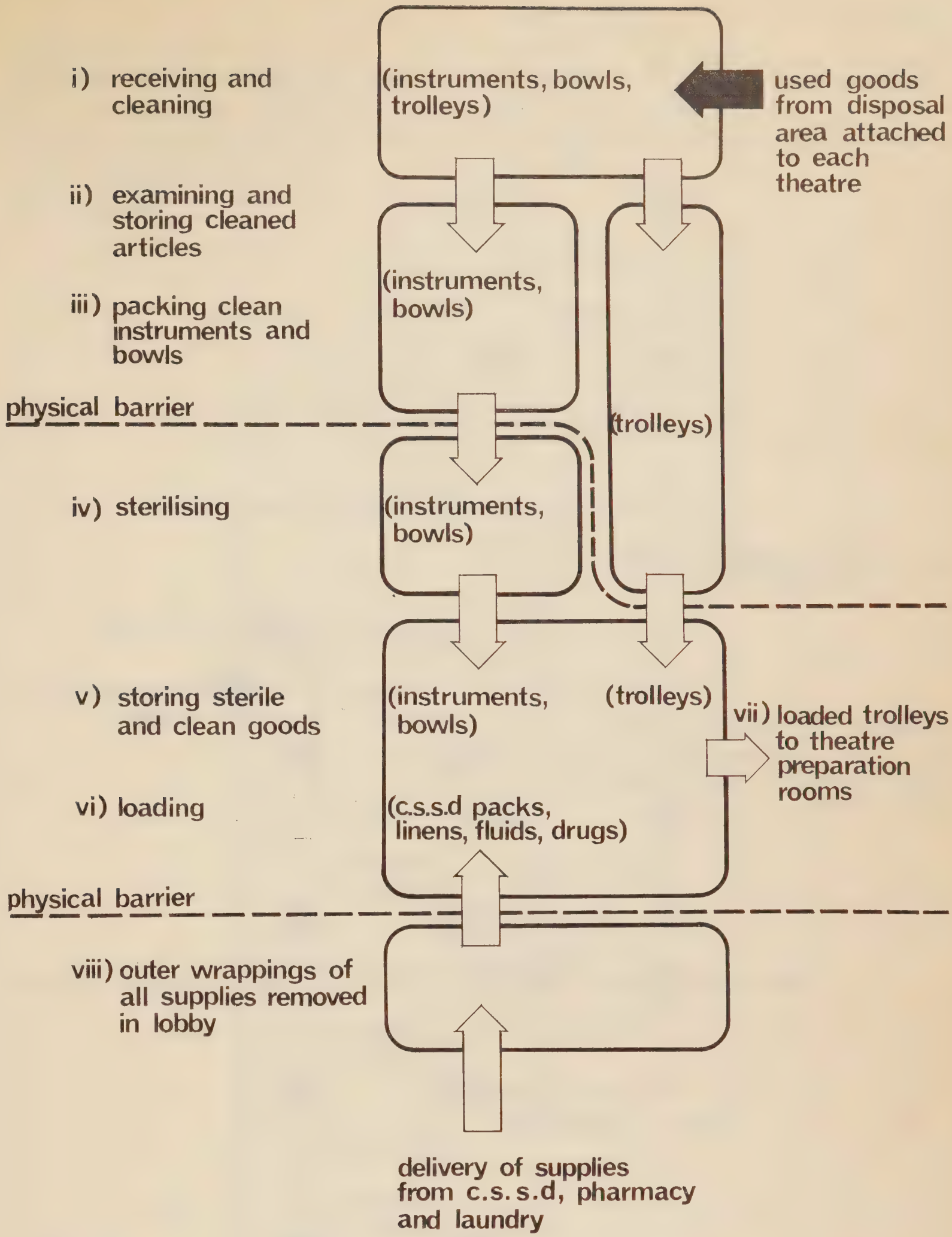


Figure 2

T.S.S.U. (theatre sterile supply unit). Diagram showing the functions of the T.S.S.U.

Figures 3

Variations on grouping theatre suites and the T.S.S.U. 'Theatre suite' means the individual suite consisting of theatre, anaesthetic room, scrub-up, exit lobby, preparation room and disposal area. Different numbers of 'theatre suites' are shown in each diagram but this is not intended to suggest that the particular number of theatre suites should necessarily be grouped in the way illustrated.

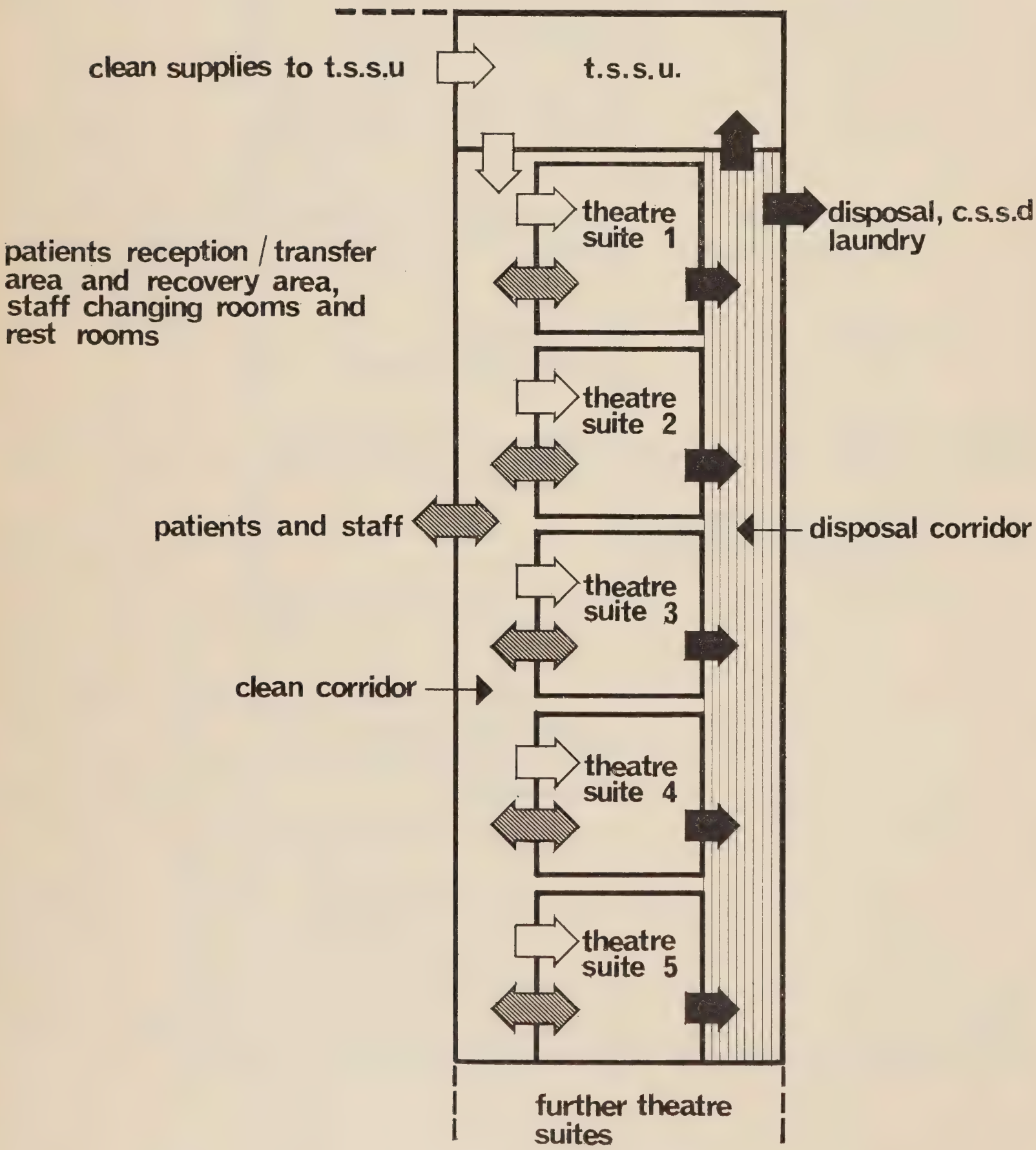


Figure 3(a)

Linear plan with T.S.S.U. at one end. This allows clean supplies to enter the T.S.S.U. without passing through the clean corridor. This plan involves long walking distances between the T.S.S.U. and the furthest theatre where there are more than about five theatres within the group.

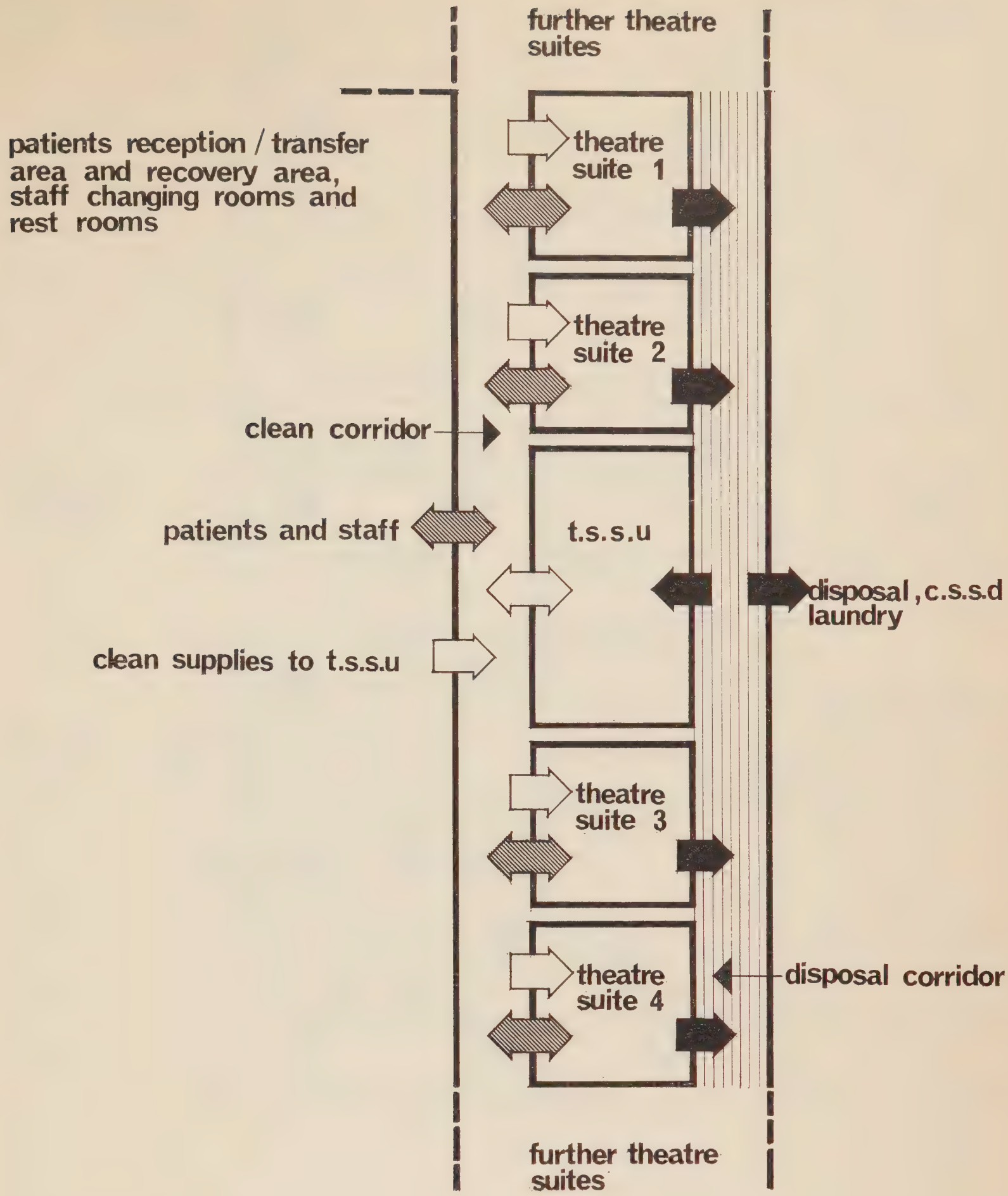


Figure 3(b)

Linear plan with T.S.S.U. placed centrally. This plan involves shorter walking distances between the T.S.S.U. and the furthest theatre but longer distances between these theatres and the reception and recovery areas. Clean supplies being delivered to the T.S.S.U. must cross the clean corridor.

KEY

patients and staff

clean / sterile supplies

used / dirty supplies

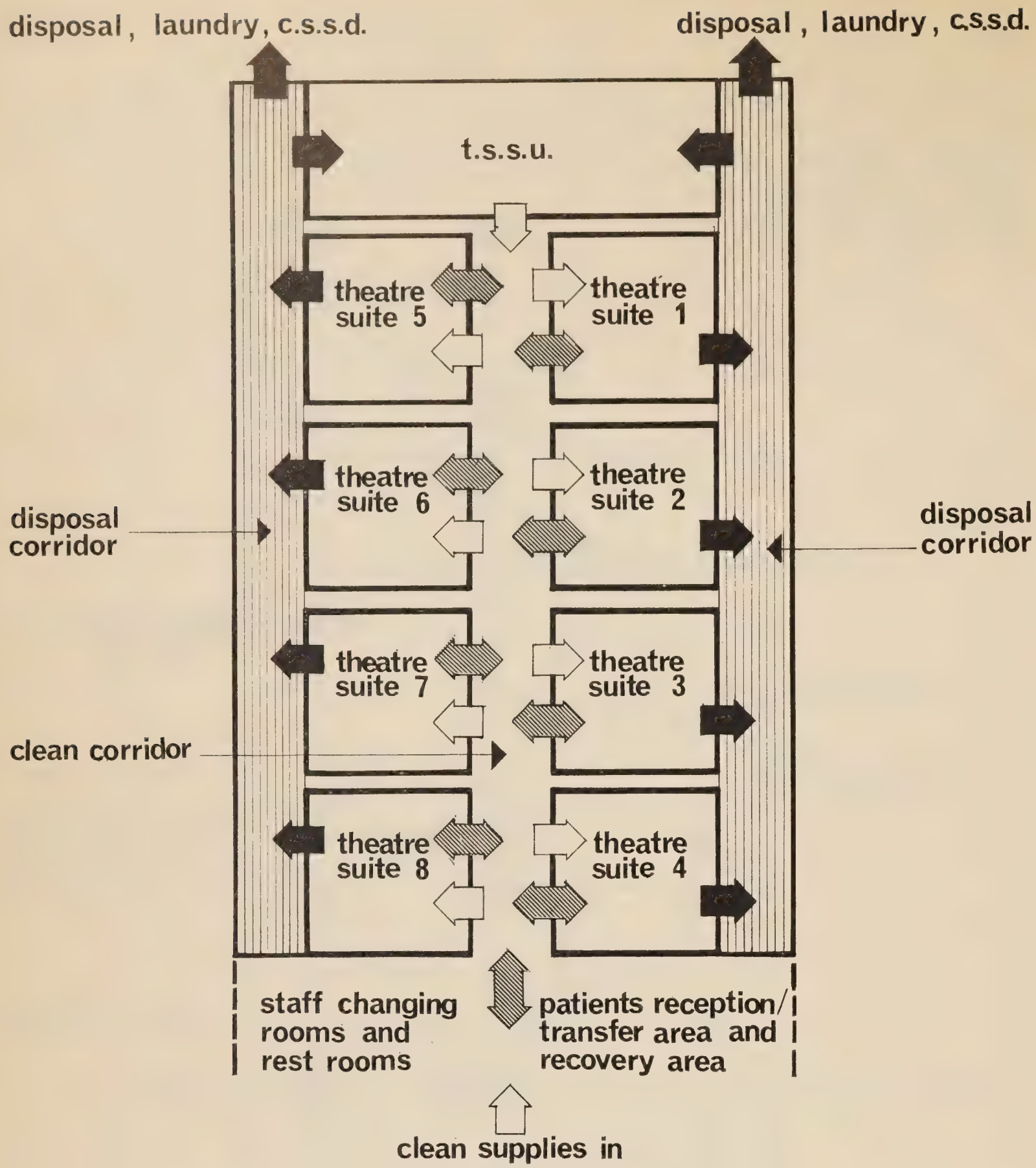


Figure 3(c)

Department with a central clean corridor and two separate disposal corridors. This plan shortens the walking distance between the furthest theatres and the T.S.S.U. But the clean supplies must pass through the clean corridor to reach the T.S.S.U., if only one entrance to the department is allowed for.

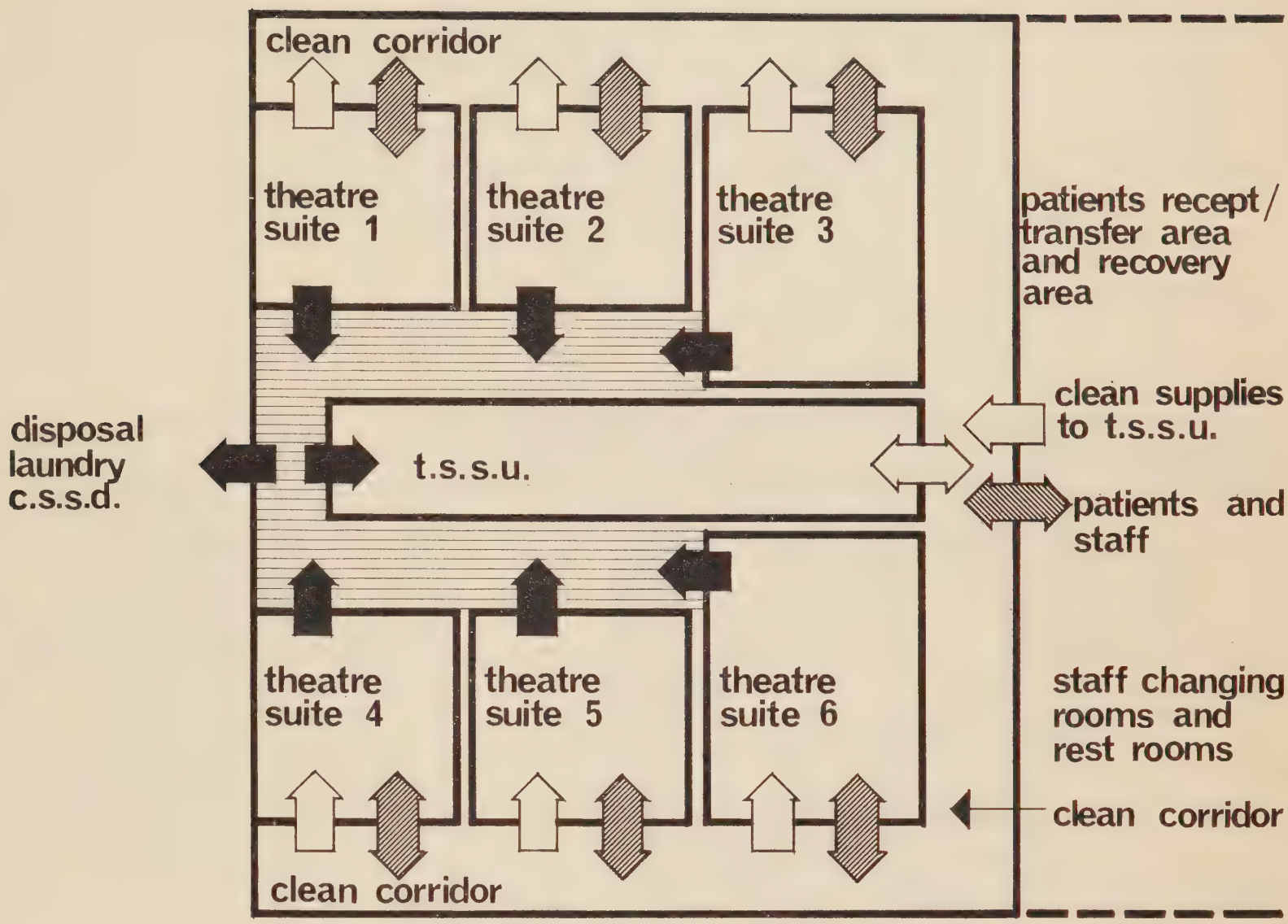


Figure 3(d)

Department with separate clean corridors and centrally placed T.S.S.U. In this plan the clean supplies going to the T.S.S.U. do not interfere with theatre traffic. But the area of the circulation space is larger.

KEY

patients and staff

clean/sterile supplies

used/dirty supplies

Figures 4

Layout of individual theatre suites

(1) These layouts indicate some of the possible ways of planning individual operating theatre suites. The special characteristics of each layout are noted below each figure. The importance of these characteristics will usually depend upon the theatre organisation (e.g. where the patient is transferred to the operating table, whether sterile packs are opened in the preparation rooms or the theatre, etc.) and upon whether it is considered necessary to have a straight run through between operating theatre and exit lobby.

(2) All rooms are shown with an area of at least the recommended size (drawn to 1/16 in. scale). In several cases some rooms have larger areas to provide a satisfactory overall layout.

(3) Areas marked with a cross indicate that space must be allowed for service ducts. Some of the areas shown are large enough to accommodate also individual storage cupboards for the theatre suite.

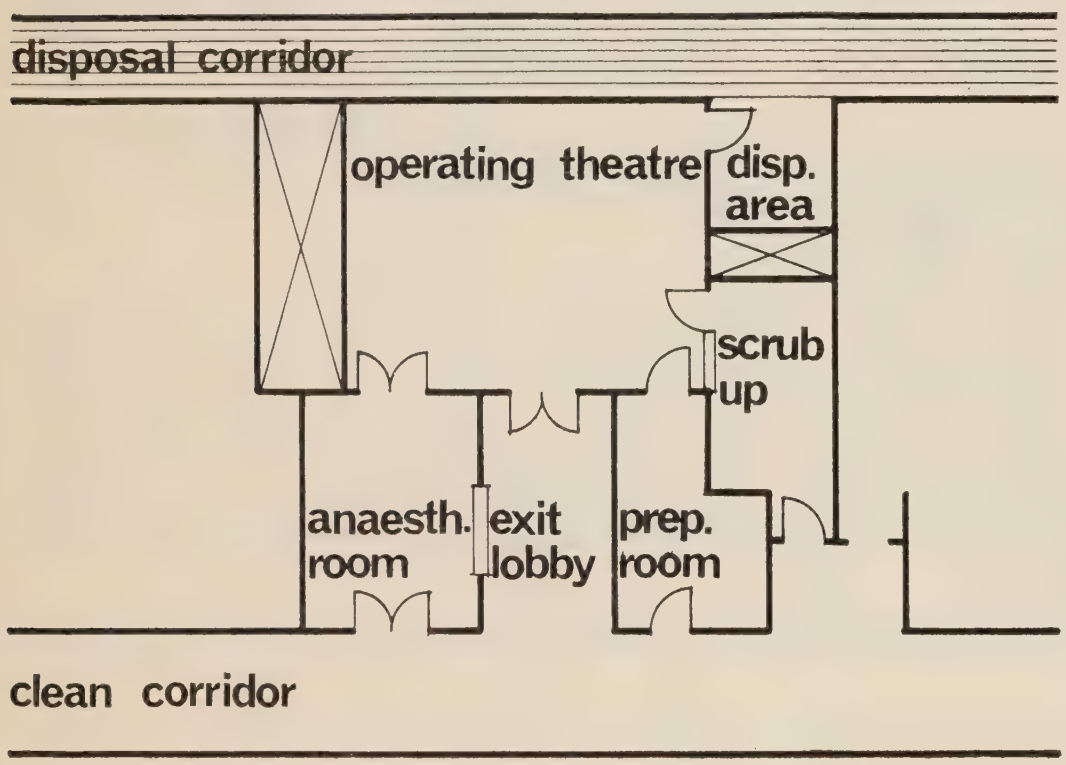


Figure 4(a)

(i) Straight run through between anaesthetic room and theatre and between theatre and exit lobby.
(ii) Anaesthetic room wide enough to have built-in equipment both sides of room.
(iii) Rectangular theatre.
(iv) The diagram shows a 'handed' plan, but the layout could be used for a repeat plan also.

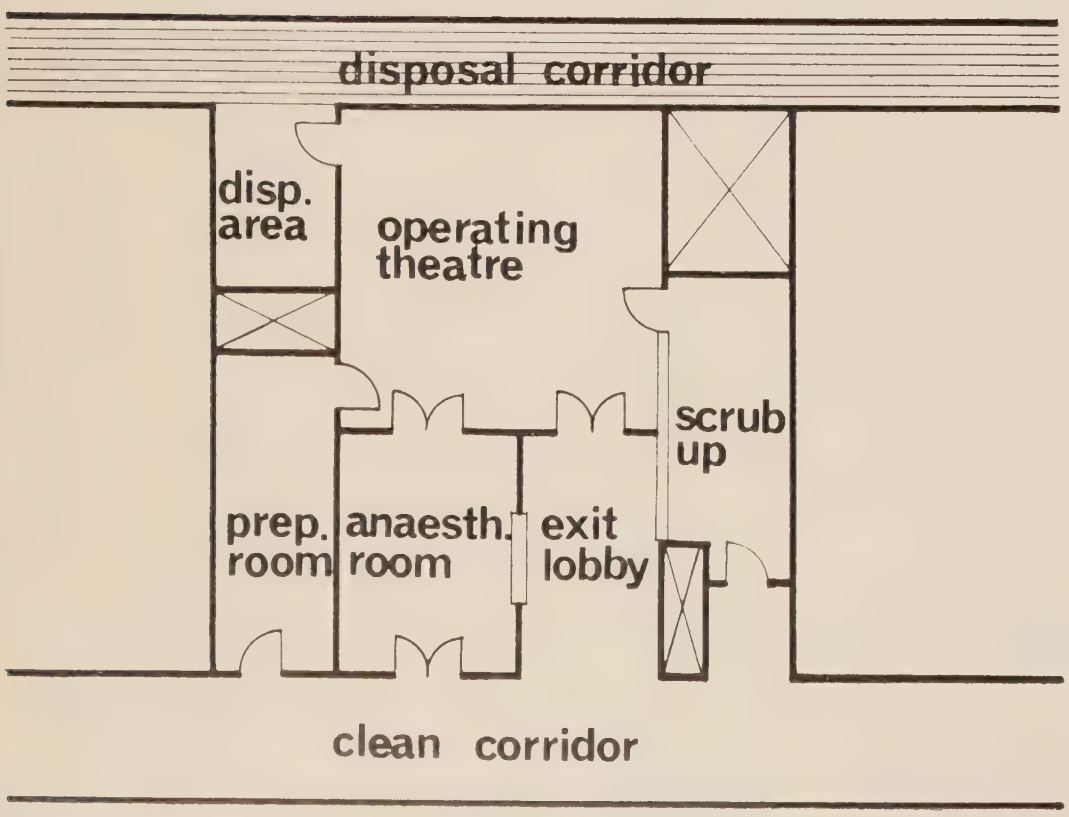


Figure 4(b)

(i) Straight run through between anesthetic room and theatre and between theatre and exit lobby.
(ii) Anaesthetic room wide enough to have built-in equipment both sides of room.
(iii) Large duct space by scrub-up which could be used as spare room.
(iv) This plan can be 'handed' or a repeat plan.

Figure 4(c)

(i) Straight run through between anaesthetic room and theatre and between theatre and exit lobby.
(ii) Anaesthetic room wide enough to have built-in equipment both sides of the room.
(iii) Shared exit lobby between two different operating theatre suites. This arrangement may not always be considered satisfactory.
(iv) This plan must be 'handed'.

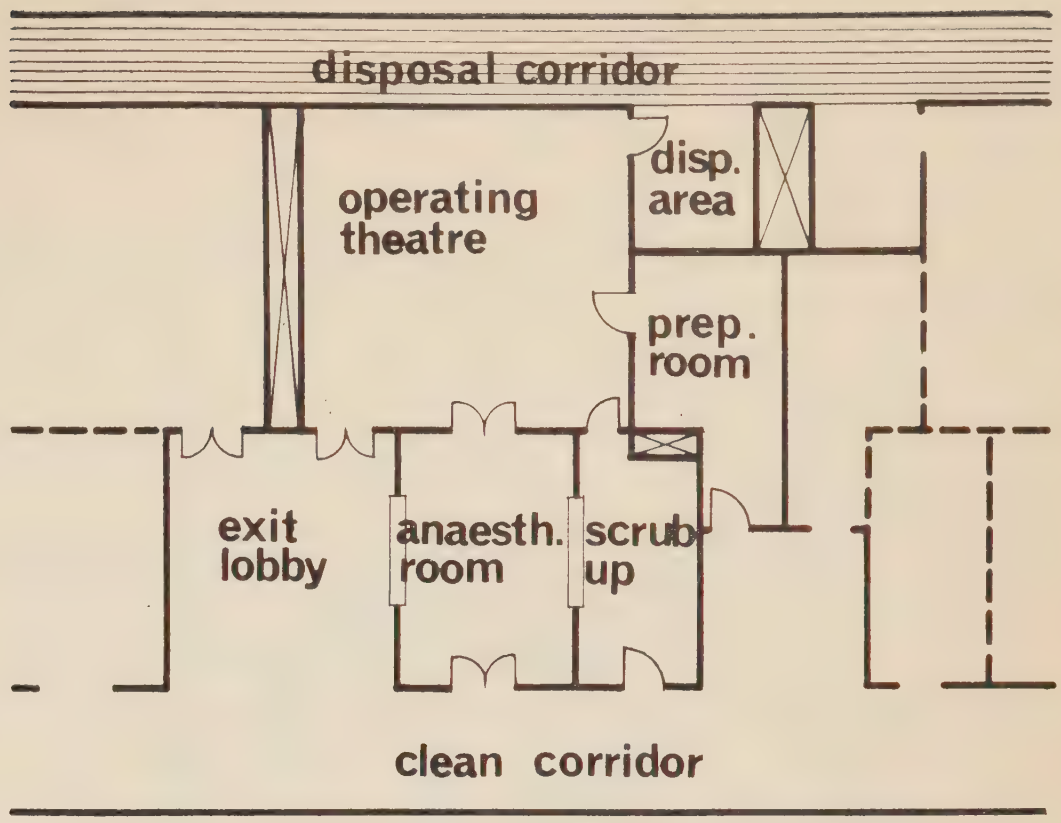


Figure 4(d)

(i) No straight run through between anaesthetic room and theatre nor between theatre and exit lobby.
(ii) A spare room opens off the exit lobby; this could be used as a monitoring room, equipment store, etc.
(iii) The anaesthetic room is narrow and only suitable for built-in equipment on one side of the room.
(iv) This plan can be 'handed' or a repeat plan.

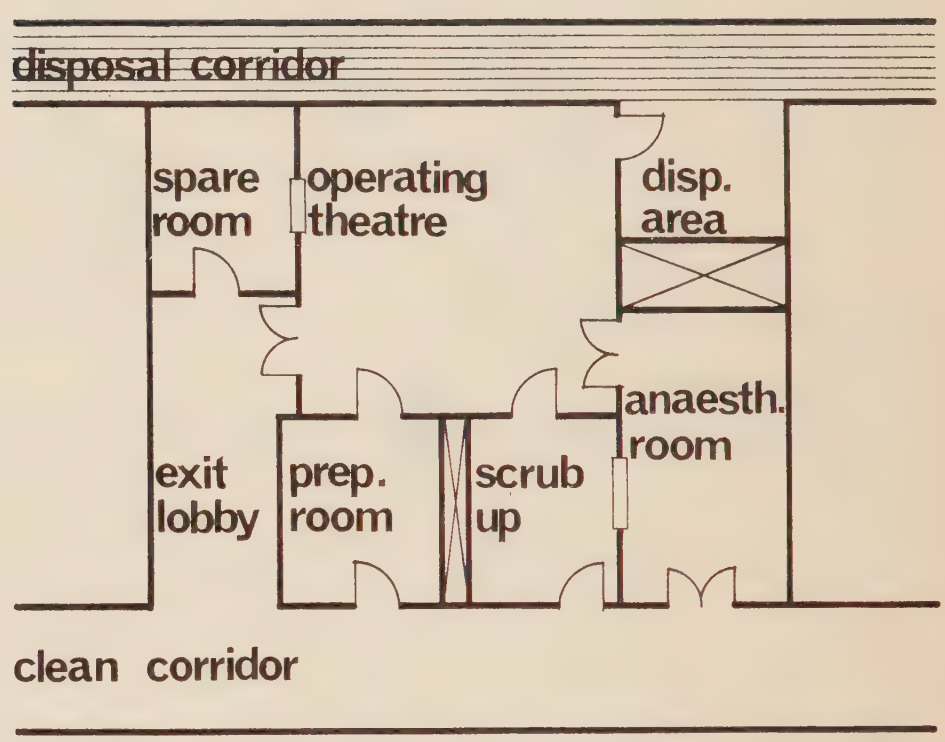
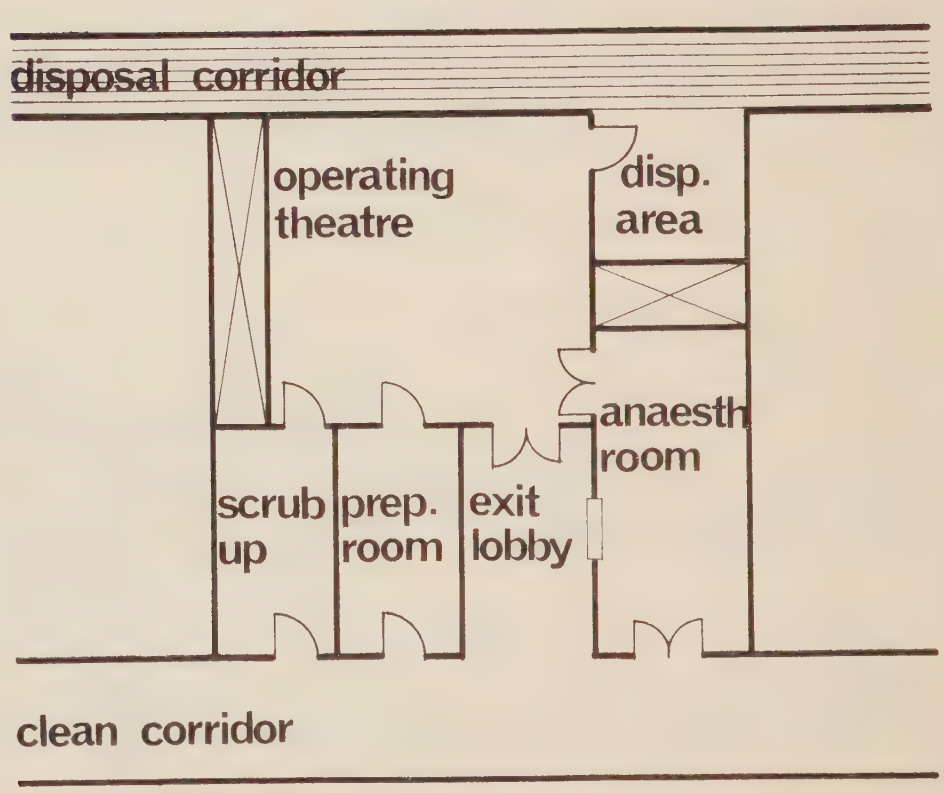


Figure 4(e)

(i) No straight run through between anaesthetic room and theatre.
(ii) Straight run through between theatre and exit lobby.
(iii) The anaesthetic room is narrow and only suitable for built-in equipment on one side of the room.
(iv) This plan can be 'handed' or a repeat plan.



Figures 5

Reception, transfer and recovery areas

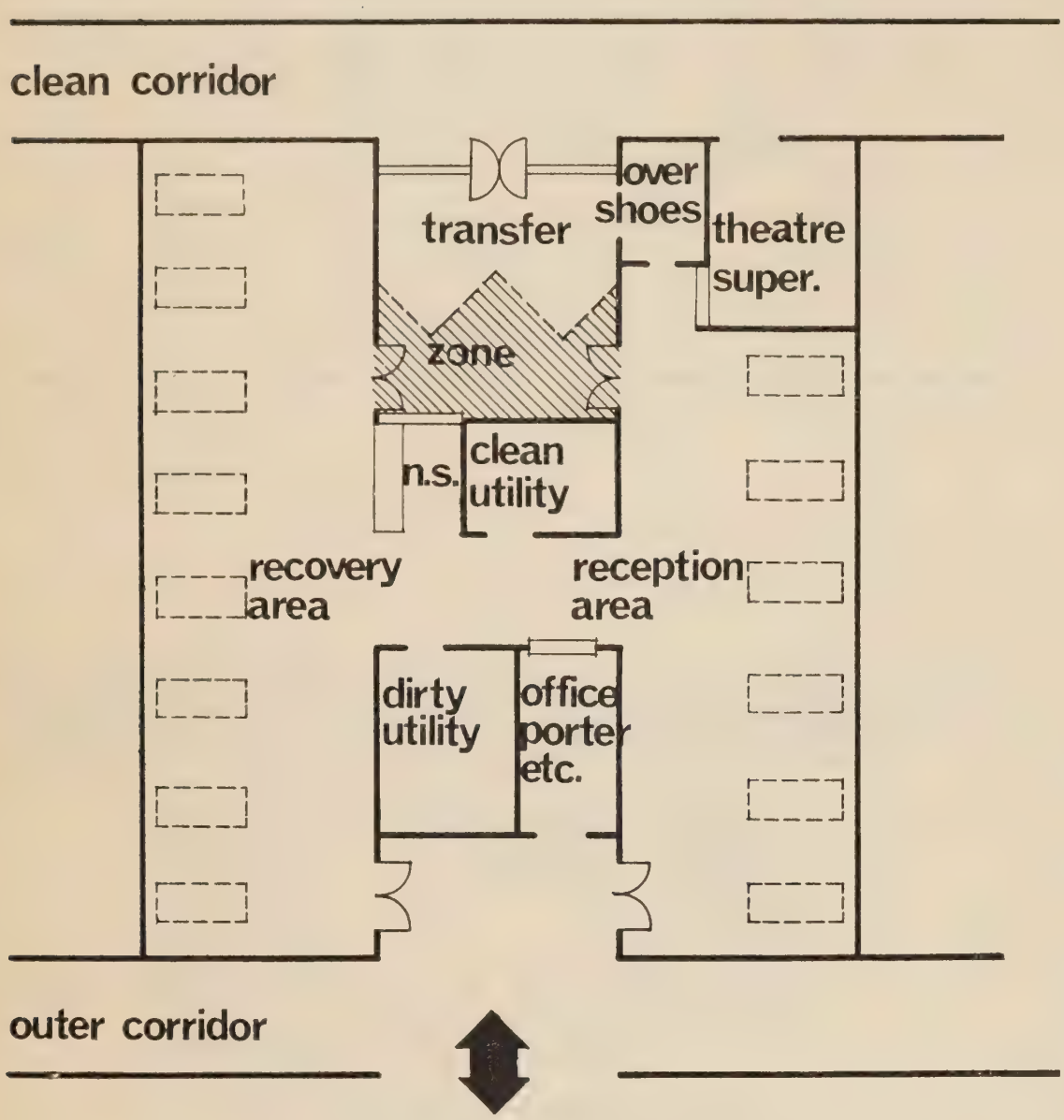


Figure (5a)

Transfer zone on clean corridor side. No bed/trolley park required.

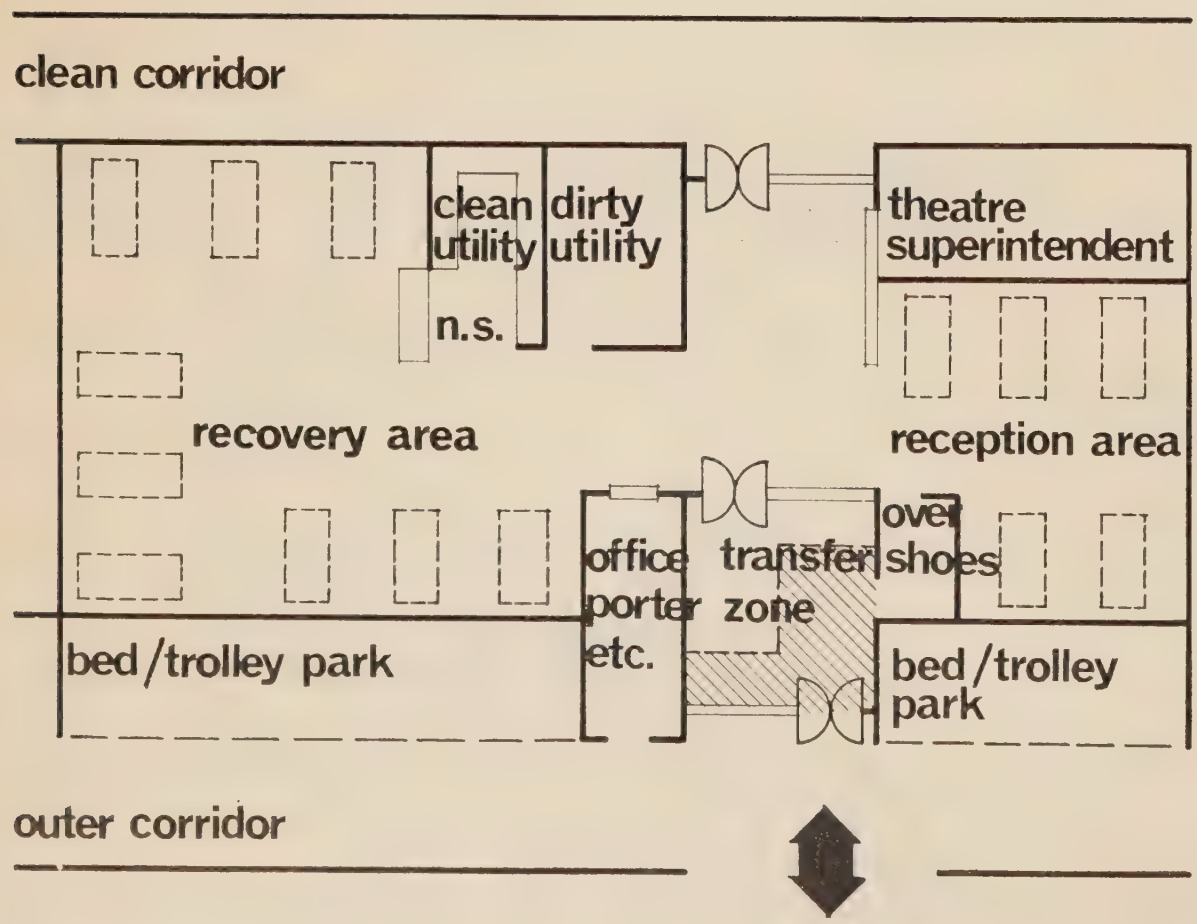


Figure 5(b)

Transfer zone on outer corridor side. In this case a bed/trolley park is required.

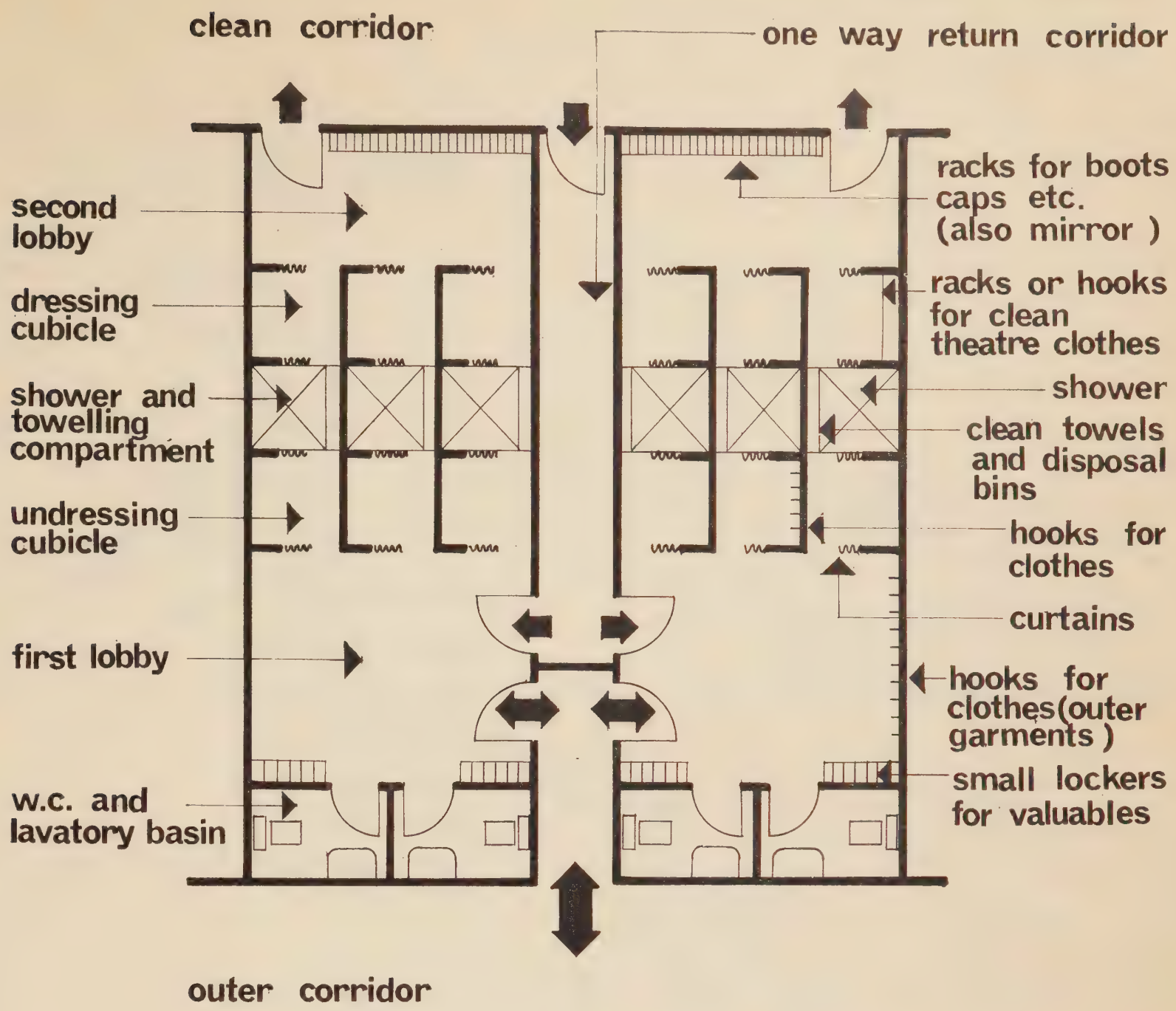


Figure 6
Staff Changing Accommodation

This diagram shows one way of planning changing accommodation. It shows how staff could progress in privacy through changing accommodation in an orderly sequence of activities without turning back at any stage from a cleaner into a less clean area, showering en route if this is considered desirable. Other patterns may be appropriate, but if adequate arrangements are not made for staff to change in privacy, the system on which the design is based will not be followed, e.g. through staff changing in the W.C.

The lobbies, cubicles and shower compartments can be used in a number of ways, for example,

1. Staff remove outer garments in first lobby and leave valuables in lockers; they move to cubicle and remove under-wear and leave on hooks.
2. Staff go via shower compartment to dressing cubicle, showering and towelling if this is considered appropriate. Used towels are left in bag beside shower.
3. Staff pick up theatre clothes and re-dress in dressing cubicle, moving to the second lobby to put on caps and boots.

On return from the theatre staff re-enter via a one-way access direct to the first lobby. They change back to their outer clothes or uniform in their original cubicle or first lobby, having showered if desired (towel collected in lobby en route). Theatre clothes and towels (if any) are disposed of in linen bags and valuables retrieved from the lockers before leaving.

Figure 6 seeks only to illustrate the principle of an orderly and satisfactory sequence of activities. Discussion continues as to the most effective regimen. There are mixed medical opinions as to the desirability of showering before an operation. The extent of showering facilities should be decided in the light of the local operational policy.

Figures 7

Typical airflow diagrams

KEY

- major air flow
- minor air flow
- air inlet
- F flap valve
- M mechanical extract
- duct to outside

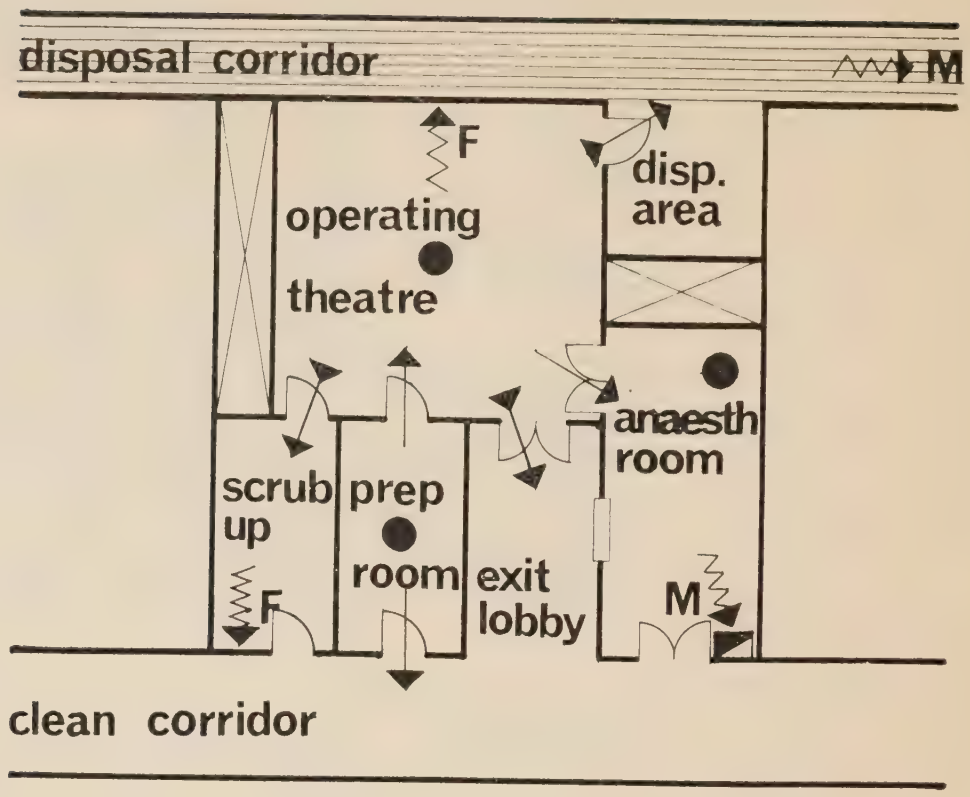


Figure 7(a)

Theatre suite (Layout as in Figure 4(e))

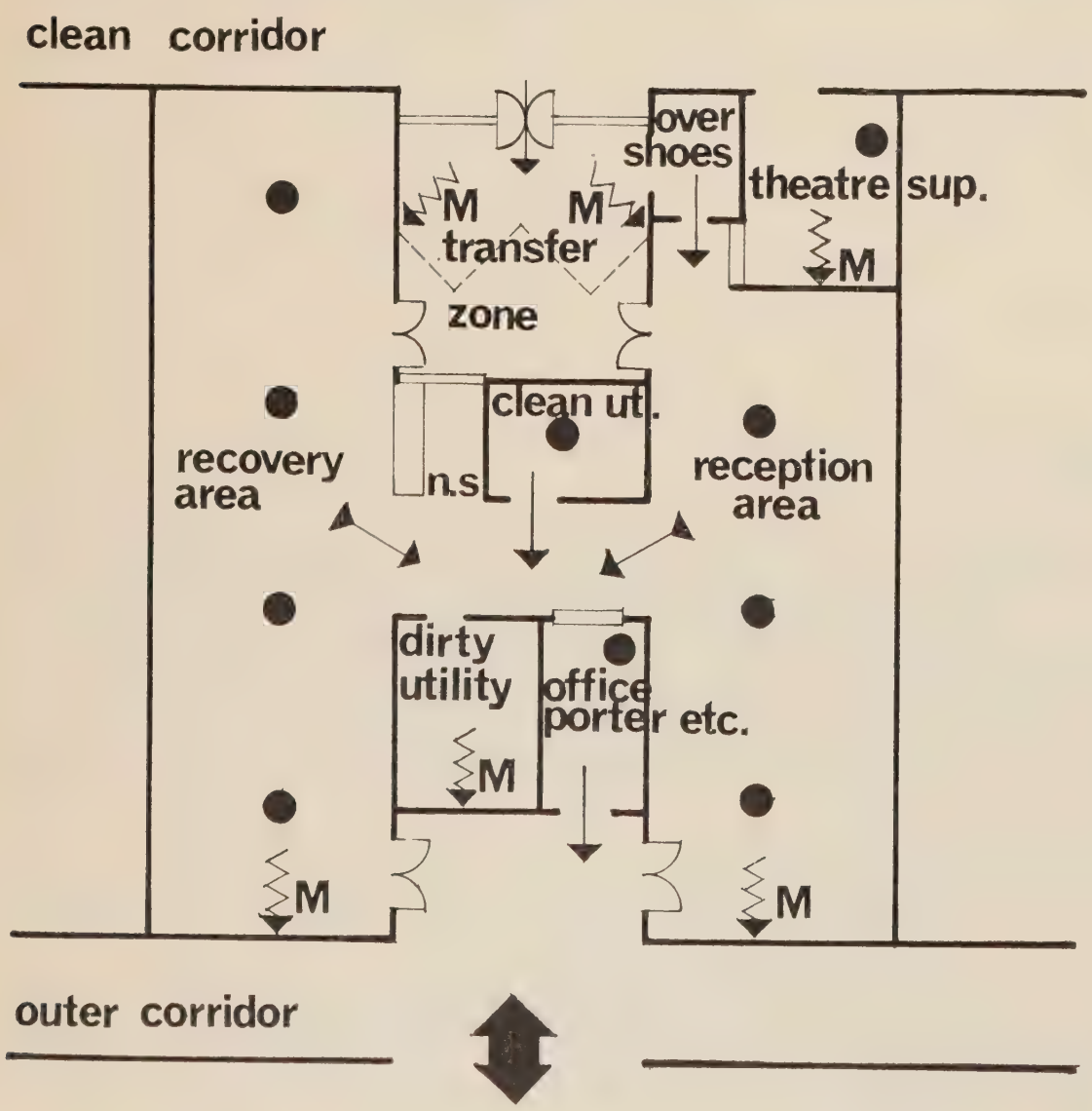


Figure 7(b)

Reception, transfer and recovery areas.
(Layout as in Figure 5(a))

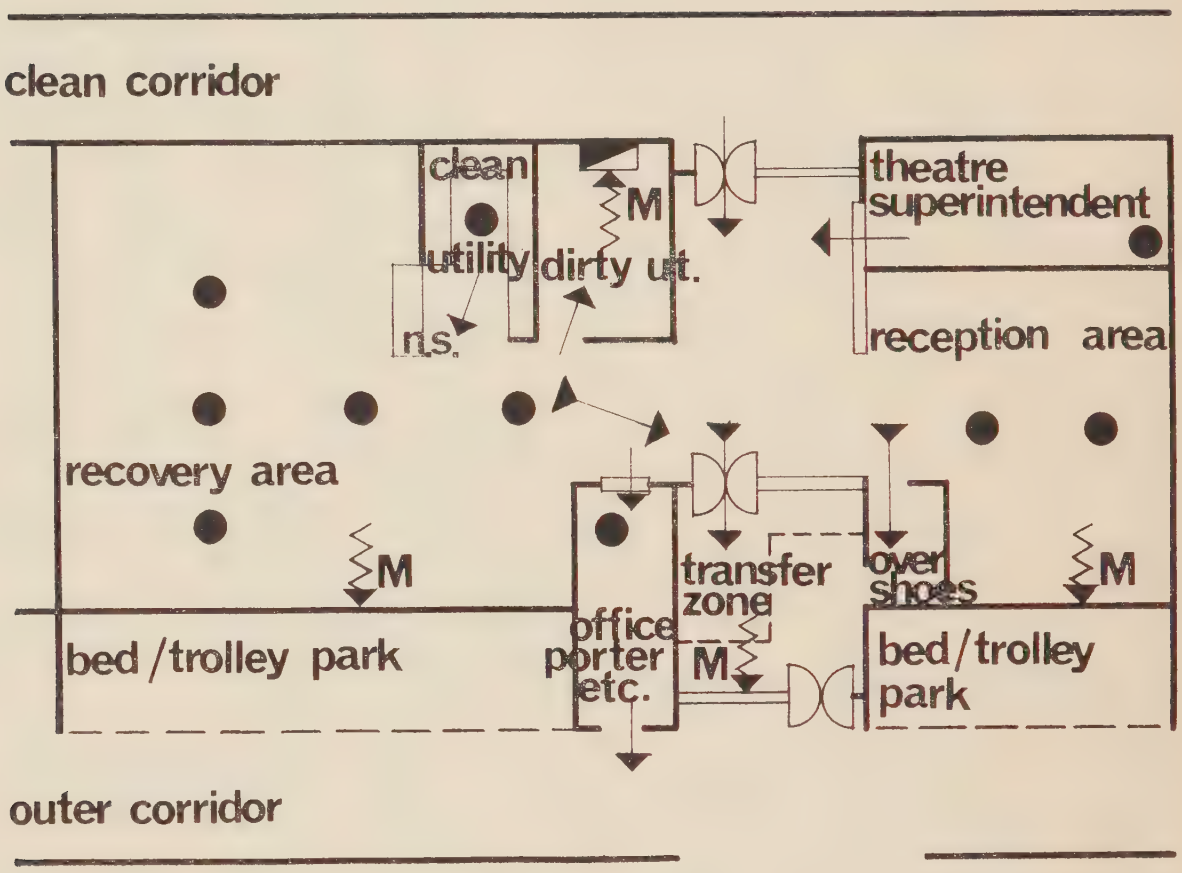
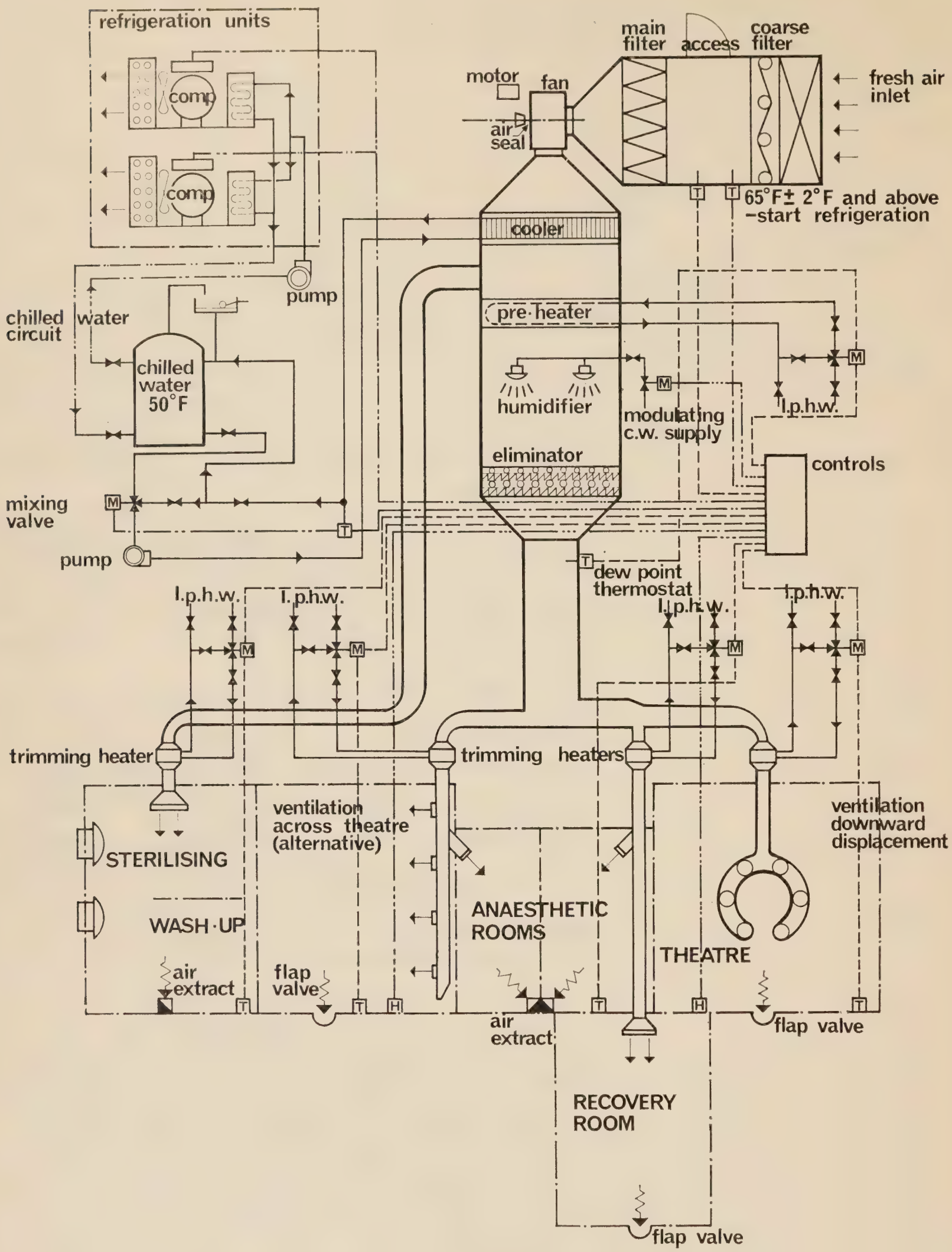


Figure 7(c)

Reception, transfer and recovery areas. (Layout as in Figure 5(b))

Figure 8

Control diagram. Operating theatre suites: ventilating plant with cooling coil



Notes

(1) Air leakage is outwards
(2) Fresh air inlet above roof level
(3) Humidifier spinning disc type or sprays
(4) Nylon type moisture eliminator
(5) Ventilation to theatres may be downward or across
(6) Refrigeration energised by rise in outside temperature
(7) Refrigeration 'on' then preheater is 'off'
(8) No humidification for air supply to sterilising room
(9) Mechanical extract from anaesthetic and wash-up area
(10) Cooler must be placed with cooling fins vertical

Basic accommodation	Suggested room size (sq ft)	Four theatres (room sizes)	Six theatres (room sizes)	Eight theatres (room sizes)	Remarks
(*a*) *Theatre suites and related rooms*					
(i) Entrance and porter's station	240	240	240	240	
(ii) Reception/transfer area: reception area	Approx. 70 sq ft per bed plus circulation	280 sq ft plus circulation	420 sq ft plus circulation	560 sq ft plus circulation	One bed per theatre. If the transfer area is planned on the outer corridor side of the department a bed/trolley parking area will be required.
transfer area	240	240	240	240	
(iii) Changing rooms for theatre, T.S.S.U. staff, etc. (see paragraph 50)	12 sq ft per person				The total area provided will be determined by the numbers of staff and normal staggering of sessions.
Sanitary facilities for theatre staff (see paragraph 50)	6 sq ft per person				
(iv) Rest rooms:					
(*a*) Medical staff	150	150	200	250	
(*b*) Nursing staff	150	150	200	250	
(*c*) Orderlies and technicians	100	100	125	150	
(v) Office for theatre superintendent	120	120	120	120	
(vi) Office for theatre sisters	120	Not likely to be required	If required	120	
(vii) Scrub-up and gowning area (One individual theatre suite)	100	4 of these rooms	6 of these rooms	8 of these rooms	In order to obtain a satisfactory overall layout it will often be necessary to vary the areas of ancillary rooms.
(viii) Theatre preparation room	120				
(ix) Anaesthetic room	180				
(x) Operating theatre	400				
(xi) Exit lobby	—				
(xii) Disposal and cleaning area	50				
(xiii) Disposal corridor (including staff w.c. and storage for cleaning)	—	—	—	—	
(xiv) Stores: (*a*) Per theatre	10	4 rooms	6 rooms	8 rooms	
(*b*) General equipment	150	150	150	150	
(xv) Store for mobile x-ray	(10 sq ft per machine)	10	20	30	Dependent on number of x-ray machines.
(xvi) Darkroom	50	50	50	50	
(xvii) Tea pantry	50	50	50	50	
(xviii) Recovery area	(100 sq ft per bed)	600	900	1,200	1½ beds per theatre.
(xix) Ancillary rooms for recovery area:					
(*a*) Clean utility and nurses' station	80–100	80–100	80–100	80–100	
(*b*) Dirty utility	100	100	100	100	
(xx) Cleaners' room:					
(*a*) Clean area of department (domestic staff for cleaning theatres)	100	100	100	100	
(*b*) Outer corridor side of department (for reception and recovery and staff changing, etc.)	50	50	50	50	
(xxi) Plant room (excluding space for refrigeration plant if required)		800	1,100	1,400	Area dependent on number and nature of the actual plant accommodated.
(xxii) Circulation space within the above area					
(*b*) *Theatre sterile supply unit* (*T.S.S.U.*)	1,200	1,200 ←——→		2,000	
(i) Receiving and cleaning area	250				The overall size of this unit will depend upon the amount of work done and number of other theatres, (accident department theatres etc.). The breakdown of working areas is a suggestion only. (v) and (vi) will be required in all departments, whether a T.S.S.U. is provided or not. Where all sterilisation is done in a C.S.S.D., the area will be required as the sterile store for the department.
(ii) Examining and storing area (ii) and (iii)	250				
(iii) Packing area (ii) and (iii)					
(iv) Sterilising area	250 includes service area				
(v) Storage for clean and sterile goods (v) and (vi)	450				
(vi) Loading area (v) and (vi)					
(vii) Delivery lobby	100				

Possible breakdown of working area

Appendix II

Air Cooling Coil System using special coils

1. This Appendix describes an 'Air Cooling Coil System' tested in trials by the Ministry of Health; and explains the difference between this system and the conventional cold water spray method of cooling.

2. Both systems use refrigeration to cool the air supply to the theatre. With conventional air conditioning the incoming air is cooled to about 52°/54°F dew point by direct contact with cold water sprays using re-circulated water. The air at this temperature becomes saturated and is then re-heated to give the temperature and humidity conditions required before entering the theatre. In the cooling coil system, warm fresh air is cooled to about 60°/65°F by cooling coil which is normally adjusted not to extract any moisture unless the dew point of the air exceeds 52°/54°F. The cooling water for the coil is on a closed circuit (as in a car radiator) and does not come into contact with the air.

3. A temperature reduction of up to 15°F can be achieved when the outside air temperature is 80°F or over. Re-heat is usually unnecessary but the temperature of the cooling water circulating in the coil can be reduced so as to give a greater reduction of air temperature and some de-humidification as may be desired.

4. In both systems the air is supplied to the theatre at a temperature of about 3°F to 5°F below the working temperature to allow for heat pick-up from the theatre without the creation of cold draughts. Relative humidity is controlled so as not to fall below 50 per cent as a precaution against static electricity.

5. Tests carried out on existing conventional air conditioning spray washers and capillary humidifiers over a long period confirm the risk of bacterial growth on wet surfaces and contamination of the re-circulated water unless stringent cleaning and maintenance is carried out. Chemical treatment is unreliable mainly because of the difficulty of regulating the dosage so as to maintain the appropriate solution strength in the face of irregular evaporation and water make-up consequent on weather conditions. There is as yet no wholly satisfactory chemical additive which does not produce an adverse effect on the theatre air, nor is there any generally accepted method of chemical treatment.

6. The tests carried out so far by the Ministry indicate that the surface of a cooling coil or battery placed up-stream to the humidifier remains dry. Bacterial tests produced satisfactory results.

7. Refrigeration for the cooling coil system can be obtained as a package unit for one or two theatres; no more than about half refrigerating capacity calculated by conventional methods is needed; and the unit may be fitted at reasonable cost to existing installations which require summer cooling, an expedient not possible with a conventional system which would take up much more space and be more costly.

8. Where more than two theatres need to be cooled a central refrigerating plant to provide chilled water would be more flexible and economic than several package units, and in this situation it is necessary only to pipe the chilled water to the cooling coils or batteries. Thus a greater cooling load can be made available to any particular theatre, or a shared cooling load may be spread over a number of theatres.

9. A typical refrigeration unit for two theatres comprises twin hermetically sealed compressors, each of 3 tons refrigeration capacity which incorporate self-contained air-cooled condensers and water coolers. The compressors are relatively quiet in operation and where possible should be placed on the ground to avoid noise penetration to the theatres. The chilled water is piped at a temperature of not more than 50°F to a 100-gallon insulated store cylinder, by which means the compressors run for periods of 15–20 minutes and thus avoid excessive and irregular starting and stopping. The use of a three-port mixing valve, controlled from a thermostat on the water outlet from the coil, enables the necessary accuracy of control of the coil surface temperature to 52°/54°F, or slightly less if specially required. It is extremely difficult to maintain the required surface temperature at 52°/54°F by the use of direct expansion refrigeration, hence the use of chilled water to obtain the necessary control.

Cooling coil

10. The cooling coils in the Ministry trials were of special design and the following precautions were taken to avoid the possible danger of bacterial growth on the cooling coil battery:

(i) The coil was placed after the main filter so that it comes into contact with air from outside the building only after it has been filtered.

(ii) The principle on which the cooling coil battery operates is counteraction of the effects of rising outside temperatures. It is operated automatically by a thermostat when the outside temperature reaches 63°/65°F and continues in use until the temperature falls below 65°F. As the outside air temperature increases, the mixing valve supplies cooler water to the battery in order to maintain a constant leaving air temperature of about 62°/68°F, according to the setting of the thermostat on the chilled water circuit.

The moisture content of the outside air is normally about the same as that required in the theatre, and the coil was therefore designed to minimise the extraction of moisture and remain dry unless outside conditions of high humidity require de-humidification, e.g. during thunderstorms and heavy rain. The design allows for a suitable air velocity over the cooling surface of the battery and the by-pass coefficient of the fins was such that any moisture deposited on the vertical surfaces drained off as it formed. When the dew point of the outside air does not exceed 53°/54°F the coils will remain dry or dry out quickly. A special trial of the coil showed that from a wet condition it will dry off from the upper to the lower portions in 2–8 minutes.

(iii) The coil is of copper construction with a secondary cooling surface of copper fins. After assembly it was dip-tinned and the excess tin removed by a centrifugal spinning process to leave smooth surfaces and smooth rounded joints between tube and fin to avoid the lodgement of fine dust particles, etc.

(iv) To enable sterilising to be carried out by steam on a similar principle to that used for milk cooling coils in the pasteurisation process, the coil may be 'boxed in' by louvres provided at the up-stream and down-stream sides of the

coil, and low pressure steam can be blown into the 'box', carrying a suitable germicide with it, for a period of up to 30 minutes; the coil meanwhile being isolated and drained of cooling water.

(v) The coil is removable from its casing between filter and pre-heater and access for examination of the coil at both sides is easy.

11. The effectiveness of the cooling coil system in existing theatres where severe over-heating has been experienced in the past was demonstrated on the few occasions in 1963 and 1964 when outside temperatures rose to 75°/80°F. At 75°F outside temperatures, temperatures of 68°/70°F were maintained in the theatre; and at 80°F outside temperature, theatre temperatures of 71°/73°F were maintained. With improved design layout, the removal of sterilisers, steam and condense piping, and other sources of avoidable heat gains from the vicinity of operating theatres, the general increase in ventilation rates and the improved air distribution recommended in this Building Note, it is to be expected that the conditions in many existing theatres which have been overheated in the past will be improved upon in the future.

12. The trials showed that satisfactory day-to-day performance depends on the proper use of the equipment provided. Tampering with automatic temperature and humidity controls should not be allowed in any circumstances.

References

1. Ministry of Health and Department of Health for Scotland Hospital Building Bulletin No. 1. Operating Theatre Suites (now out of print).
2. Report of the Royal College of Surgeons of England on the Design of Operating Theatre Suites.
3. Report of Operating Theatre Hygiene Sub-Committee to the Medical Research Council Committee on the Control of Cross Infection. (The Lancet, 10th November, 1962.)
4. Medical Research Council (1962) Design and Ventilation of Operating Room Suites for the control of infection and for comfort. (The Lancet, 10th November, 1962; the Architects' Journal, 14th November, 1962; Journal of the Institution of Heating and Ventilating Engineers, 10th December, 1962.)
5. Institution of Heating and Ventilating Engineers (1959). A guide to current practice.
6. Hospital Engineering Research Unit (1964). Summary of the study of the water, electricity and medical gas services in operating theatre suites.
7. The Institution of Electrical Engineers Regulations for the Electrical Equipment of Buildings (current edition).
8. Scottish Home and Health Department: Hospital Planning Note No. 1: Ward Design.

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9. Hospital Building Note No. 4 (Revised). Ward Units (not yet published).
10. Hospital Building Note No. 22. Accident and Emergency Department (H.M.S.O.).
11. Hospital Technical Memorandum No. 1. Anti-static Precautions: Rubber, Plastics and Fabrics. (H.M.S.O.)
12. Hospital Technical Memorandum No. 2. Anti-static Precautions: Flooring in Anaesthetising Areas. (H.M.S.O.)
13. Hospital Technical Memorandum No. 7. Electrical Services: supply and distribution. (H.M.S.O.)
14. Hospital Technical Memorandum No. 8. Safety Code for Electro-Medical apparatus. (H.M.S.O.)
15. Hospital Technical Memorandum No. 10. Pressure Steam Sterilisers. (H.M.S.O.)
16. Hospital Technical Memorandum No. 11. Emergency Electrical Services. (H.M.S.O.)
17. Hospital Technical Memorandum No. 14. Abatement of Electrical Interference. (H.M.S.O.)
18. Hospital Technical Memorandum No. 16. Fire Precautions. (H.M.S.O.)
19. Report of a working party on Anaesthetic explosions including Safety Code for equipment and installations. (H.M.S.O., 1956.)
20. Hospital Fire Precautions HM(56)36.

British Standards Institution

21. B.S. 1363 Two-pole and earthing-pin fused-plugs and shuttered socket outlets for A.C. circuits up to 250 volts.
22. B.S. 2831 Methods of Test for Air Filters used in Air Conditioning and General Ventilation.
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24. B.S. 3219 Horizontal cylindrical hospital sterilisers: pressure steam type.
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26. B.S. 3233 Pressure Steam Sterilisers of small size (with independent steam supply) for unwrapped instruments and utensils.

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